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BOTANY.—*Plants new to Arizona. (An annotated list of species added to the recorded flora of the state or otherwise interesting).** By THOMAS H. KEARNEY, Bureau of Plant Industry.

Arizona has a rich and remarkable flora. The great diversity of natural conditions produces a corresponding diversity of life forms and floral elements. There could scarcely be a greater contrast than that between the Sonoran flora of the hot deserts of the southwestern part of the state, only a few hundred feet above sea-level, where cacti and other xerophytic forms predominate, and the arctic-alpine flora of the summit of San Francisco Mountain, with an altitude of nearly 13,000 feet. The mean annual rainfall ranges from 3.5 inches at Yuma to 30 inches at Crown King in Yavapai County.

Several floral provinces meet and overlap in Arizona. On the grass-covered plains of the eastern section, there are numerous species characteristic of the Great Plains region from Kansas to Texas. The Rocky Mountain flora is well represented on the higher mountains. The Great Basin region of Utah and Nevada shares many of its species with northern Arizona. Constituents of the flora of the Mohave Desert region are found in large number near the western edge of the state. In southwestern Arizona there are many species that occur elsewhere only along and near the Gulf of California. A large number of Mexican and Central American species, more or less tropical in their affinities, just cross the southern border of the state. There are even, in southeastern Arizona, a few species whose main center of distribution is the Atlantic and Mississippi Valley States. Finally, of course, many Old World species have become established as weeds.

During the past five years, extensive collections of the flowering plants and ferns of Arizona have been made by members of the Bureau of Plant Industry, U. S. Department of Agriculture, whose headquarters

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are the U. S. Field Station at Sacaton, on the Gila River, some 45 miles southeast of Phoenix. This group includes George J. Harrison, Robert H. Peebles, Harold F. Loomis, Harold J. Fulton, Chalmers J. King, and the writer. Frank A. Thackery, A. R. Leding, and M. French Gilman of the Bureau of Plant Industry and W. J. Osborn of the Forest Service, with headquarters at Flagstaff, also have contributed materially to the Sacaton collection.

A list of the flowering plants and ferns of Arizona, with keys to the families, genera and species, is being compiled by Ivar Tidestrom of the Bureau of Plant Industry, with the collaboration of other botanists. The time therefore seems opportune to publish notes on plants collected by the Sacaton botanists, many of which, so far as the writer can ascertain, have not been recorded hitherto as occurring in Arizona. Our collections have added some 55 species and varieties to the known flora of the state, of which 18 were found only in the region lying between the Gila River and the Mexican frontier and between the Baboquivari Mountains and the Colorado River. This is the country of the Papago Indians and includes much of the territory known to the early Spanish missionaries as "Papaguería." The additions to the flora discovered in this region are chiefly species that occur in Lower California and the adjacent Colorado Desert of California or in Sonora and other parts of Mexico. The relative inaccessibility of much of this area and the rarity of sufficient precipitation to permit the growth of plants make it likely that other species not known to belong to the flora of Arizona and of the United States will be discovered there in the future.

In our explorations of southwestern Arizona we have observed a tendency to the rapid eastward spread of species mainly characteristic of the region near the mouth of the Colorado River. Such are *Aristida californica*, *Sphaeralcea orcuttii*, *Asclepias erosa*, and *Palafoxia linearis*. All of these plants have readily disseminated seeds. Since they have been noticed chiefly along the highway from Yuma to Phoenix, it may be conjectured that paved roads and automobile traffic have aided their dispersal.

The area centering in the Pinal Mountains, a few miles north of the Gila River, has yielded several additions to the recorded flora. The southeastern part of the state, between the Baboquivari Mountains and the New Mexican boundary, has been much explored by other botanists, but we have found there a good number of species not hitherto recorded as belonging to the Arizona flora. The area north of the Gila River, between longitude 112° and the Colorado River, like the

southwestern corner of the state, is difficult of access and is characterized by very low and very sporadic precipitation. Exploration of this region on the rare occasions when conditions have been favorable to plant growth, is likely to reveal the presence of many species of southeastern California and southern Nevada that have not yet been collected in Arizona.

Ten of the 99 species and varieties listed in this paper are not known to occur elsewhere than in Arizona. The principal distribution of the others, outside this state, may be summarized as follows:

Pacific coast region (Washington to Lower California)	10
California deserts (Colorado, Mohave, etc.)	6
Gulf of California region (Lower California, western Sonora)	14
Mexico (not confined to the preceding region) and southward	33
Rio Grande region (western Texas, southern New Mexico and adjacent Mexico)	4
New Mexico only	4
Plains region (Kansas, Texas, etc.)	2
Atlantic and Mississippi Valley States	5
Old World and indigenous in Arizona	1
Old World (introduced species)	9
Tropical America (introduced species)	1

It will be noted that the distribution outside of Arizona, of nearly half of the species and varieties listed is in the Gulf of California region or elsewhere in Mexico and tropical America. This does not signify a corresponding preponderance of these elements in the flora of Arizona, but merely that our explorations have been carried on largely in portions of the state where they are likely to be found in the greatest numbers.

Fascinating problems in plant geography are encountered in studying the Arizona flora. One of these is the occurrence, well toward the center of the state and especially in the Pinal Mountain region, of species identical with or very closely related to constituents of the chaparral of the mountains and coast of California. Such are *Dryopteris arguta* (Kaulf.) Watt, *Grossularia quercetorum* (Greene) Cov. & Britt., *Cercocarpus douglasii* Rydb., *Rhus ovata* Wats., *Rhamnus californica* Eschs. (represented by *R. ursina* Greene), *Rhamnus crocea ilicifolia* (Kellogg) Greene, *Ceanothus integerrimus* H. & A. (represented by *C. mogollonicus* Greene), and *Lonicera interrupta* Benth. None of these are found in the intervening deserts. Another remarkable case of interrupted range is afforded by a few species having their main center of distribution in the Atlantic States and the Mississippi Valley and occurring also in southern Arizona but apparently not in west-

ern Texas and southern New Mexico. Examples are: *Phytolacca americana* L., *Crotalaria sagittalis* L., *Clitoria mariana* L., *Isanthus brachiatus* (L.) B. S. P., and *Galium pilosum* Ait.

In the following list, species and varieties which, so far as the writer knows, have not been recorded in a previous publication as occurring in Arizona are indicated by a single asterisk. Double asterisks indicate that the plant is believed to be new to the recorded flora of the United States, also. Four of the species listed were described for the first time from our collections. None of these is known to occur outside of Arizona. The assistance of authorities who have identified some of the plants, as mentioned in the footnotes, is acknowledged with gratitude.

POLYPODIACEAE[1]

ASPLENIUM PALMERI Maxon. Collected on the western side of the Baboquivari Mts. in Pima Co. by Harrison in 1927. This is considerably farther west than the previously known station in Arizona, the Mule Mts. in Cochise Co., where it was collected by L. N. Goodding. This fern also occurs in the Organ Mts., New Mexico.[2] It is chiefly a Mexican species, of rare occurrence in the United States.

CETARACH DALHOUSIAE (Hook.) C. Chr. (*Asplenium alternans* Hook). Collected on the western side of the Baboquivari Mts. by M. French Gilman, thus extending the known range considerably to the west, the only previously recorded stations in Arizona, both in Cochise Co., being the Huachuca Mts. (*J. H. Ferris*) and the Mule Mts. (*L. N. Goodding*). This fern is not known to occur anywhere else in the western hemisphere, but is found in the Himalayas and in Abyssinia. This remarkable distribution has been discussed by W. A. Poyser, J. H. Ferris, and W. N. Clute.[3]

CHEILANTHES LENDIGERA (Sav.) Sw. Collected by Peebles and Loomis in Cave Creek Canyon, Chiricahua Mts., Cochise Co. The only locality previously known for this fern in Arizona and in the United States is the Huachuca Mts., in Cochise Co., where it was collected by J. G. Lemmon and by M. E. Jones. The species is widely distributed in tropical America.

CHEILANTHES VILLOSA Davenp. Collected in the Sierra Estrella, south of Phoenix, Maricopa Co., by Kearney, Harrison, Peebles, and Loomis in 1926. This is considerably farther west than the stations previously known in Arizona, which are the Santa Catalina, Santa Rita, Huachuca, and Chiricahua Mts.[4] Occurs also in New Mexico, western Texas, Chihuahua, and Coahuila.

[1] Identified by W. R. Maxon, who supplied much of the information given in the notes on this family.

[2] W. R. Maxon in Am. Fern Journ. **18**: 105. 1921.

[3] Fern Bull. **19**: 33-42. 1911. See also W. R. Maxon in Am. Fern Journ. **3**: 110. 1913. Similar distribution of another fern was noted by C. W. Hope (Bull. Torr. Club **26**: 58-62. 1919), who considers *Asplenium glenniei* Baker, found in the Huachuca Mts., Arizona, and in Mexico, to be identical with *A. exiguum* Bedd., of India and southern China.

[4] See W. R. Maxon in Proc. Biol. Soc. Wash. **31**: 142-4. 1918.

*DRYOPTERIS ARGUTA (Kaulf.) Watt. Collected by Harrison in Devils Canyon, near Superior, in Pinal Co., in 1926. Known previously to occur only from southern California to western Oregon.[5]

PHANEROPHLEBIA AURICULATA Underw. Collected on the west side of the Baboquivari Mts., Pima Co., by A. R. Leding in 1925, and previously in the same mountains by Forrest Shreve. These stations are considerably farther west than any known hitherto for this fern in Arizona.

WOODSIA PLUMMERAE Lemmon. Collected near Prescott, Yavapai Co., by Harrison in 1927, extending the known range considerably to the northwest.

POACEAE

TRIPSACUM LANCEOLATUM Rupr.[6] (*T. lemmoni* Vasey). Collected by Harrison and Kearney in the Mule Mts. near Bisbee, Cochise Co., and by Loomis near Patagonia, Santa Cruz Co. These are apparently the only collections of this grass in Arizona and in the United States, except that of Lemmon in the Huachuca Mts. (type of *T. lemmoni*). The species is widely distributed in Mexico.

**PANICUM LEPIDULUM Hitchc. & Chase.[7] Collected by Kearney and Harrison near Nogales, Santa Cruz Co., in 1927. Mrs. Chase informed the writer that ours was the first collection of this species in Arizona and in the United States. It was previously known only from Mexico (Chihuahua, Durango, and near Mexico City).

**SCHISMUS BARBATUS (L.) Chase (*S. marginatus* Beauv.).[8] Thoroughly naturalized and apparently spreading rapidly in Maricopa and Pinal counties; first collected by Loomis and Peebles in 1926. This Old World grass had not previously been reported as occurring in the United States.

CYPERACEAE

*CYPERUS WRIGHTII Britton.[9] Collected by Kearney and Harrison in the Huachuca Mts., Cochise Co., and by Kearney and Fulton in the Santa Rita Mts., Pima Co., apparently for the first time in Arizona. The range of the species, as previously known, is Texas, southern New Mexico, and Chihuahua.

RAFFLESIACEAE

PILOSTYLES THURBERI Gray. This interesting little parasite on the stems of a leguminous plant, *Parosela emoryi* (Gray) Heller, was found in 1930 by Harrison and Kearney and by Peebles and Loomis in considerable abundance between the north end of the Gila Mts. and the Gila River, Yuma County, beginning to flower about the first of April. The locality is probably very near the place where the plant was first discovered by Thurber in 1852. There seems to be no record of the occurrence of *P. thurberi* elsewhere east of the Colorado River, but J. B. Norton told the writer that he had found the plant in the Colorado Desert, Calif., in 1927.

[5] For the characters distinguishing *D. arguta* from the related *D. filix-mas* see W. R. Maxon in Am. Fern Journ. 11: 3, 4. 1921.

[6] Identified by J. R. Swallen.

[7] Identified by Agnes Chase.

[8] Identified by A. S. Hitchcock.

[9] Identified by N. L. Britton.

POLYGONACEAE

*POLYGONUM CAMPORUM Meisn.[10] Collected by Kearney, Harrison, and Peebles at a roadside in the Colorado River Valley below Yuma. In a letter to the writer, Dr. Small states that our plant "seems to be most closely related to *Polygonum camporum*, where I would place it, at least for the time being. It is true the akene is rather small, but we have never had enough material of *P. camporum* to properly understand the species." The range of the species, as previously known, is Nebraska to Louisiana and New Mexico, and in South America. Apparently it has not previously been collected in the United States west of El Paso, Texas.

*PERSICARIA FUSIFORMIS Greene. Collected by Kearney at the edge of running water in Sabino Canyon, Santa Catalina Mts., Pima Co. This is apparently the first collection in Arizona, although the species was described from specimens collected on the Colorado River, in California. The Arizona specimens have less pointed akenes than the California specimens, but otherwise are similar.

NYCTAGINACEAE

*MIRABILIS JALAPA L. Collected by Kearney and Harrison in Cave Creek Canyon, Chiricahua Mts., Cochise Co., in 1929, where the plants were growing wild although possibly as an escape from cultivation, this being the common four-o'clock of gardens. Apparently the first collection in Arizona, the previously known range of the species in the wild being from southern Texas through Mexico to Central and South America.

*BOERHAAVIA GRACILLIMA Heimerl. Collected in Baboquivari Canyon, Pima Co., by Loomis, and previously by M. E. Jones in the Huachuca Mts. The recorded range of the species is southwestern Texas and southern New Mexico to Oaxaca and Lower California.

PHYTOLACCACEAE

*PHYTOLACCA AMERICANA L. (*P. decandra* L.) Collected in shaded alluvial ground along the Sonoita near Patagonia, Santa Cruz Co. Although the plants grew wild, their progenitors may have been introduced by man, this species, the common pokeberry of the eastern states, not having previously been known to occur farther west than Texas.

PORTULACACEAE

*CALANDRINIA AMBIGUA (Wats.) Howell. (*C. sesuvioides* Gray). This species was collected by Peebles and Harrison in 1928 near Dome, Yuma County, and previously in Arizona, probably by J. J. Thornber, but apparently the plant has not been recorded as occurring outside the Colorado Desert, in California.

SILENACEAE

*SILENE ANGLICA L. (*S. gallica* L.). Collected by Peebles on hillsides along Salt River below the Roosevelt Dam in Maricopa Co. and previously, probably by J. J. Thornber, in the Santa Rita Mts., Pima Co. Although extensively naturalized on the Pacific Coast, this European plant apparently has not been recorded as occurring in Arizona.

[10] Identified by J. K. Small.

*SAPONARIA OFFICINALIS L. This Old World species, thoroughly naturalized in many parts of the United States, is well established in the vicinity of Prescott, where a peculiar form with inflated calyx was collected by Fulton.

BRASSICACEAE

*LEPIDIUM DRABA L. Collected near Prescott by Loomis, presumably for the first time in Arizona. Introduced from Europe and naturalized in many parts of the United States.

*SISYMBRIUM IRIO L. Abundantly naturalized near Sacaton and Casa Grande, Pinal Co., and in the Salt River Valley, Maricopa Co. Introduced from Europe.

*LYROCARPA COULTERI Hook. & Harv. Found by us at several stations between Maricopa and Yuma, growing among bushes in partial shade. There are specimens in the Gray Herbarium of Harvard University collected in Arizona by Palmer and either in Arizona or northern Sonora by Pringle, but the occurrence of the species in this state seems not to have been definitely recorded hitherto. The range outside of Arizona is California (Colorado Desert) to Lower California and Sonora.

CRASSULACEAE

GRAPTOPETALUM ORPETTII E. Walther.[11] Collected in 1926 by Harrison on the high plateau between Superior and Miami, in Pinal Co. The type of the species is a subsequent collection by Ed. Howard, at or near the same locality.

*TILLAEA ERECTA H. & A. Collected by Peebles and Loomis in Baboquivari Canyon, Pima Co., and by Kearney, Harrison, and Peebles in Paradise Valley, Maricopa Co., where it was rather abundant at a roadside. This represents apparently the first collection of any species of the genus in Arizona. The range of *T. erecta*, as previously recorded, is Oregon to Lower California, and in Chile.

GROSSULARIACEAE

*GROSSULARIA QUERCETORUM (Greene) Coville & Britton.[12] Collected by Harrison and Fulton on Superstition Mountain, northern Pinal Co., at an elevation of about 4,000 feet. Previously collected by J. J. Thornber in the Sierra Estrella, Maricopa Co., and on Superstition Mountain by L .N. Goodding. These Arizona collections, as Dr. Coville points out, greatly extend the range of the species which previously had been known only from middle California to Lower California.

ROSACEAE

*CERCOCARPUS DOUGLASII Rydb.[13] Common in Devils Canyon near Superior, Pinal Co., where it was collected by Kearney and Harrison. This locality is far outside the previously recorded range of the species, which is California and southern Oregon, near the coast.

[11] Walther, Eric. A new species of Graptopetalum. Journ. Cactus and Succulent Soc. Amer. 1: 183-186. 1930.

[12] Identified by Frederick V. Coville.

[13] Identification confirmed by P. A. Rydberg.

MIMOSACEAE

MIMOSA LAXIFLORA Benth.[14] The first collection of this species in Arizona and in the United States appears to have been by the late Professor J. Arthur Harris at Quijotoa, in the Papago Indian Reservation, Pima Co., in 1925. Harrison subsequently found it to be rather abundant in a wash near Sells, (Indian Oasis), in the same reservation, growing as a much branched shrub about 4 feet high. The species was previously known to occur only in Chihuahua, Sonora, and Sinaloa, Mexico.

CAESALPINIACEAE

HOFFMANSEGGIA MICROPHYLLA Torr.[15] Rather abundant on rocky foothills of the Gila and Tinajas Altas Mts., in Yuma County, where it was collected by Harrison in 1927. The range as previously recorded is southern California (Colorado Desert) to Lower California and Sonora.

FABACEAE

*CROTALARIA SAGITTALIS L. Collected by Kearney and Harrison in Garden Canyon, Huachuca Mts., Cochise Co. and in a sandy "wash" near the Patagonia Mts., in Santa Cruz Co. Previously collected in Arizona by T. E. Wilcox in the Huachuca Mts.[16] and by J. C. Blumer in the Chiricahua Mts., Cochise Co. The range of the species in the United States, as previously recorded, is New England to Minnesota, Florida, and Texas. Apparently it does not occur in western Texas and New Mexico, but many specimens collected in Mexico and Central America have been identified as *C. sagittalis*. The Arizona plant looks very different from the common form of the eastern United States, having shorter stems, shorter and relatively broader leaves, inconspicuous or obsolete and not decurrent stipules and smaller pods. It has been given a different species name, but since this name appears not to have been published it is omitted here, in order not to increase the synonymy of this perplexing group. Occasional specimens of *C. sagittalis* from east of the Mississippi, e.g. specimens collected by Oakes at Plymouth, Mass., are practically identical with the Arizona form. Very similar specimens collected in Mexico are: *C. Wright* 1019, from Santa Cruz, Sonora; *E. Palmer* 712, from Alamos, Sonora; and *Townsend & Barber* 307, from near Colonia Garcia.

**LUPINUS SUCCULENTUS BRANDEGEI C. P. Smith.[17] Collected by Kearney, Harrison, and Peebles near Camp Creek, Maricopa Co., and near Roosevelt, Gila Co., in 1928. These collections represent a great extension of range of the variety *brandegei*, known previously only from Lower California. Specimens of a more typical form of *L. succulentus* Doug., were collected by Miss Alice Eastwood near Roosevelt, Ariz.[18]

**TRIFOLIUM AMABILE H. B. K. Collected in Garden Canyon, Huachuca Mts., Cochise Co., by Kearney in 1928, and previously in the same vicinity by F. X. Holzner. These appear to be the only collections in Arizona and in

[14] Identification confirmed by N. L. Britton.

[15] Identification confirmed by J. N. Rose.

[16] Britton, N. L. and Kearney, T. H., Jr. An enumeration of the plants collected by Dr. Timothy E. Wilcox, U. S. A., and others in southeastern Arizona during the years 1892-1894. Trans. N. Y. Acad. **14**: 21-44. 1894. In this publication the species is listed doubtfully as *C. rotundifolia* (Walt.) Poir.

[17] Identified by Charles Piper Smith.

[18] C. P. Smith in Bull. Torr. Bot. Club **49**: 203. 1922.

the United States of this species of clover, which is widely distributed in Mexico and Central America.

*PAROSELA JAMESII (Torr.) Vail. Collected near Sonoita, Santa Cruz Co., by Peebles and Loomis in 1928, presumably for the first time in Arizona. The range as previously recorded is Kansas and Colorado to New Mexico, Chihuahua and Coahuila.

*PETALOSTEMON STANDLEYANUS Rydb.[19] Collected near Prescott by Harrison, Peebles, and Kearney in 1927, presumably for the first time in Arizona. The species was known previously only from northern New Mexico.

SPHINCTOSPERMUM CONSTRICTUM (Wats.) Rose. Collected near Nogales by Kearney in 1927 and previously at Tucson by J. J. Thornber. These apparently are the only localities in the United States where this interesting little annual, with curiously constricted seeds, is known to occur. It is found also in Sonora and Lower California.

ZORNIA DIPHYLLA (L.) Pers. Specimens collected by Kearney, Harrison, and Peebles near Nogales, Santa Cruz Co., differ from the form commonly occurring in Arizona in their long, very narrow, long-acuminate leaves, longer and more acuminate bracts, and absence of pubescence except on the margins of the bracts. Similar specimens have been collected in Mexico and Central America.

MEIBOMIA GRAMINEA (Gray) Kuntze. This species, characterized by long, narrow, unifoliolate leaves, was collected in Baboquivari Canyon, Pima Co., by Kearney, Harrison, and Peebles in 1925. Apparently the only previous collection in Arizona was that of the type of *Desmodium gramineum* Gray by C. Wright on Sonoita Creek, in what is now Santa Cruz County.[20] The species ranges southward, to Costa Rica. Its occurrence in New Mexico is mentioned by Miss Vail,[21] but it is not included by Wooton and Standley in their flora of that state.[22]

*MEIBOMIA WRIGHTII (Gray) Kuntze. Collected in Baboquivari Canyon by Kearney, Harrison, and Peebles in 1925. The range of this species, as previously recorded, is Texas, New Mexico and Mexico. A. K. Schindler (MS.) apparently does not recognize *M. wrightii* as distinct from *M. psilophylla* (Schlecht.) Kuntze, but specimens of the latter from Mexico and Guatemala have narrower leaves and smaller joints of the fruit than the specimens of *M. wrightii* from Texas, New Mexico and Arizona.

CLITORIA MARIANA L. This species, collected by us in the Santa Rita Mts., Pima Co., and Sierra Ancha, Gila Co., but previously known to occur in southern Arizona, has an interrupted range similar to that of *Crotalaria sagittalis*. It ranges from New York to Missouri and south to Florida and central Texas, and apparently does not occur in western Texas and New Mexico.

GERANIACEAE

**GERANIUM WISLIZENI Wats. Collected in fruit in the Huachuca Mts., by Kearney, Harrison, and Peebles in 1926. The occurrence of *G. wislizeni* in Arizona and in the United States seems not to have been reported hitherto, the range as given by J. K. Small[23] being northern Mexico (Chihuahua and

[19] Identification confirmed by P. A. Rydberg.

[20] Gray, A., Plantae Wrightianae **2**: 46. 1853.

[21] Vail, Anna M., in Bull. Torr. Bot. Club **19**: 116. 1892.

[22] Wooton, E. O., and Standley, Paul C., Contr. Nat. Herb., vol. 19, 1915.

[23] North American Flora **25**: 11. 1907.

Durango). It may, however, be the plant collected in the Huachuca Mts., by J. G. Lemmon and referred by Trelease[24] to *G. mexicanum* H. B. K.

BURSERACEAE

**ELAPHRIUM ODORATUM (Brandeg.) Rose (*Bursera odorata* Brandeg.)[25] Collected by M. French Gilman near Fresnal, at the western base of the Baboquivari Mts., Pima Co., in 1927, apparently for the first time in Arizona and in the United States. A few small trees 10 to 15 feet high are growing at this station, on a hot southern slope sheltered by cliffs. The plant is remarkable for the vivid green color of the new bark, the thin, papery, easily detachable old bark, and the strong odor, resembling that of tangerines. The range of the species, as previously known, is in Mexico, from Sonora and Lower California to Morelos and Puebla.

EUPHORBIACEAE

**CROTON SONORAE Torr. A small shrub, collected by Harrison, Kearney, and Fulton on the dry rocky slopes of Table Top Mountain, in western Pinal Co., in 1930. The range of the species, as previously recorded, is Sonora to Oaxaca, Mexico.

**DITAXIS BRANDEGEI (Millsp.) Rose & Standl. Of rather frequent occurrence on dry rocky slopes of the Gila Mts., near Yuma where it was collected by Peebles in 1927. The species was previously known only from Lower California and northwestern Sonora, ours having been apparently the first collection in the United States, as well as in Arizona. In the Arizona specimens the stems are barely lignified at base.

**ACALYPHA PRINGLEI Wats. A shrubby plant, collected by the late Professor J. Arthur Harris at Quijotoa in the Papago Indian Reservation, Pima Co., in 1925. Previously known only from Mexico, where it occurs in northwestern Sonora and at San Luis Potosí (*Parry & Palmer* 824).

JATROPHA SPATHULATA (Orteg.) Muell. Collected by Kearney and Harrison in 1930 in the Tinajas Altas Mts., Yuma County, and previously there by E. A. Goldman. Both collections are of the small-leafed western form of this apparently variable species.

**SAPIUM BILOCULARE (Wats.) Pax. Collected by Harrison near Gila Bend, Maricopa Co., where it occurs in considerable numbers along a "wash" and on adjacent slopes. The plant is conspicuous because of the dark green, shining foliage. The stems here reach a height of 15 feet. The staminate flowers are very fragrant, with an odor suggesting that of plum blossoms. The species had been collected previously near Gila Bend, probably at the same station, by H. E. Hasse, and had been observed near Ajo, Pima Co., by J. J. Thornber, but the fact of its occurrence in Arizona and in the United States seems not to have been recorded hitherto. The plant is interesting as being one of the hosts of the "jumping bean" insect, larvae of which were present in the seeds at the Arizona station. With the exception of these localities in Arizona, the species is known only from Sonora and Lower California.

ANACARDIACEAE

*RHUS INTEGRIFOLIA (Nutt.) Benth. & Hook. Collected by Harrison and Kearney on the lower eastern slope of the Tinajas Altas Mts., Yuma County,

[24] In Gray and Robinson, Syn. Fl. N. Am. 1[1]: 359.

[25] Identified by P. C. Standley.

and previously at or near the same locality by E. A. Goldman. Although these specimens have narrower and more oblong leaves than most specimens from California, they seem clearly to belong to this species, which was known previously to occur only in southern California and Lower California, chiefly near the coast.

RHAMNACEAE

COLUBRINA CALIFORNICA I. M. Johnston.[26] Collected by Peebles and Harrison in Fish Creek Canyon, at the eastern end of Maricopa Co., in 1926. It occurs also on adjacent dry mountain sides, and has since been found by Harrison in a "wash" at the base of the San Tan Mts., Pinal Co. At the Arizona stations, this shrub reaches a height of 5 to 10 feet. Previously known only from Las Animas Bay, Lower California. Dr. Ivan M. Johnston, who confirmed the writer's identification of the Arizona specimens, found them to differ from his Lower California material only in the smaller size of the fruits. The genus, as well as the species, is new to Arizona.

MALVACEAE

ABUTILON PRINGLEI Hochr. This species, nearly related to *A. incanum* (Link) Sweet but apparently sufficiently distinct, seems to be more frequent than the latter in southern Arizona. Most of the specimens collected by us have longer pedicels than the type collection of *A. pringlei* by C. G. Pringle near Tucson.

*ABUTILON THEOPHRASTI Med. A single plant was found by Kearney in a cotton field in the Salt River Valley in 1929, this being apparently the first known occurrence in the state of this Old World species, which is naturalized in other parts of the United States. There is no evidence of its having become established as a constituent of the Arizona flora.

*HORSFORDIA ALATA (Wats.) Gray. Collected by Harrison at the foot of the Tinajas Altas Mts. in 1927, presumably for the first time in Arizona and in the United States.[27] It proves to be fairly abundant in "washes" at the base of the Gila and Tinajas Altas mountains in Yuma County. It is a shrub, reaching a height of 8 feet, with petals of a pale violet blue. The stems are less pubescent in the Arizona specimens than in specimens from Mexico. The range of the species, as now known, is Lower California and Sonora to southeastern California and southwestern Arizona.

*SPHAERALCEA ORCUTTII Rose. Collected by Kearney near Wellton, Yuma County, in 1927, presumably for the first time in Arizona. It has since been found to occur abundantly along the highway from Yuma to Phoenix as far east as Mohawk, Yuma County, sometimes covering whole fields and giving every appearance of being a recent and rapidly spreading introduction. Previous to our collections it seems to have been known only from the Colorado Desert in California and adjacent Lower California. The species is a well-marked one, evidently related to *S. coulteri* Gray in the characters of the fruit. Like the latter, it is annual or at most biennial in habit.

ANODA CRENATIFLORA Orteg. (?). Collected by Kearney and Harrison in rich soil among pines in Cave Creek Canyon, Chiricahua Mts., Cochise Co.,

[26] See Kearney, T. H. Plants of Lower Californian relationship in central Arizona. Journ. Wash. Acad. Sci. **19**: 70, 71. 1929.

[27] The species has since been found at the edge of the Coachella Valley, California, and a note by Davidson on its occurrence there (Bull. Southern Cal. Acad. Sci. **29**: 100. 1930) is the first published reference to its occurrence in the United States.

in 1929. The specimens were very young and had flowers with yellow petals, but no fruit. Whether they really belong to this species can not be decided until more mature specimens have been collected. *A. crenatiflora* apparently has been known only from Mexico and Lower California, but the likelihood of its being found in Arizona is mentioned by Gray and Robinson.[28]

**HIBISCUS BISEPTUS Wats. Collected by Harrison, Peebles, and Kearney in the Baboquivari Mts., Pima Co., and in Devils Canyon, Pinal Co., in 1926. These are apparently the first collections in Arizona and in the United States identified as *H. biseptus*, although it is likely that some of the Arizona specimens previously identified as *H. coulteri* Harvey belong here. The range of *H. biseptus*, as previously known, is Lower California to Chihuahua, Jalisco and Sinaloa, Mexico. The hairs of the stems in the Arizona specimens are mostly stellate, not simple.[29]

PASSIFLORACEAE[30]

*PASSIFLORA BRYONIOIDES H. B. K. (*P. inamoena* Gray). Collected by Harrison near Nogales in 1928, apparently for the first time in Arizona The range of the species, as previously known, is from Texas to Oaxaca, Mexico.

*PASSIFLORA FOETIDA L. Collected by Harrison in the Baboquivari Mts., Pima Co., in 1927, a peculiar form with deeply dissected leaves. This was presumably the first collection of the species in Arizona. The range of *P. foetida*, as previously known, is from southern Texas and southern Florida to South America.

ONAGRACEAE

*OENOTHERA CARDIOPHYLLA SPLENDENS Munz & Johnston. (Section Chylismia.) This large-flowered variety, as well as the typical form, *O. cardiophylla* Torr., is of frequent occurrence at the base of the Gila and Tinajas Altas ranges in Yuma County. Harrison and Peebles found no intergradations between the two forms. Munz[31] cites only California stations for var. *splendens*, but the writer is informed by Dr. B. L. Robinson that this variety had been collected previously in Arizona by E. Palmer.

*CIRCAEA PACIFICA Asch. & Magn. Collected by Kearney, Peebles, and Harrison in 1927 on Mt. Graham, Graham Co., where it grows abundantly in rich soil in woods at an elevation of about 6,000 feet. This is presumably the first record of the occurrence of any species of this genus in Arizona. The range of *C. pacifica*, as previously known, is California to Utah and northward.

APIACEAE

*ANETHUM GRAVEOLENS L. A single plant was found along an irrigation canal at Sacaton, Pinal Co., by C. J. King in 1926, but no specimens have been observed since. The evidence does not warrant the conclusion that this Old World species, which yields the condiment dill, has become a constituent of the Arizona flora.

[28] Syn. Fl. N. Am. **1**[1]: 321.

[29] P. C. Standley, Trees and Shrubs of Mexico. Contr. U. S. Nat. Herb. **23**: 778. 1923.

[30] Identified by E. P. Killip.

[31] P. A. Munz in Am. Journ. Bot. **15**: 227. 1928.

APOCYNACEAE

AMSONIA KEARNEYANA Woodson. First collected by F. A. Thackery on the western side of the Baboquivari Mts., Pima Co., in 1926, and the species is thus far known only from the mouths of canyons in that desert range.[32]

AMSONIA POGONOSEPALA Woodson. Collected by Kearney in a sandy wash near the Salt River, eastern Maricopa Co., in 1928. Apparently this is the only locality in southern Arizona where this species is known to occur, the only other known station being the type locality, San Francisco Mts., Coconino Co.[32]

ASCLEPIADACEAE

*ASCLEPIAS ALBICANS Wats. Collected at the base of the Tinajas Altas Mts. by Harrison in 1927, presumably the first collection in Arizona. This peculiar, leafless, desert milkweed proves to be of frequent occurrence in the foothills of the Tinajas Altas and Gila ranges, Yuma Co. It was previously known to occur only in the Colorado Desert, California, and in Lower California and Sinaloa, Mexico (doubtless also in Sonora). The stems, sometimes as many as 50 from one root, are somewhat lignified towards the base and reach a height of 10 feet and a diameter of $\frac{3}{4}$ inch.

**ROULINIELLA LIGULATA (Benth.) Standley. (*Enslenia ? ligulata* Benth.; *Roulinia ligulata* Pittier). Flowering specimens of a herbaceous climbing Asclepiad, provisionally identified as *R. ligulata*, were collected in shaded alluvial ground along the Sonoita near Patagonia, Santa Cruz Co., by Peebles in 1927. They differ from Mexican specimens of *R. ligulata* in the more deeply cordate leaves, somewhat larger flowers, and longer, more attenuate segments of the corona. *R. ligulata* is known from the States of Morelos, Puebla, and Oaxaca in Mexico. There is apparently no record of the occurrence of this genus in Arizona, and the species, whether it is *ligulata* or an undescribed one, probably is new to the United States. It is quite distinct from *R. unifaria*, which occurs in southern Texas and is the only member of the genus previously known to occur north of Mexico.

CONVOLVULACEAE

**JACQUEMONTIA PALMERI Wats. Collected in Baboquivari Canyon, Pima Co., by Peebles in 1925, presumably for the first time in Arizona and in the United States. The species had previously been known only from Sonora and Lower California.

*IPOMOEA LINDHEIMERI Gray. Collected by Harrison and Kearney near Tombstone, Cochise Co., in 1929, presumably for the first time in Arizona. The range, as previously known, is southern Texas to southwestern New Mexico and Chihuahua and Coahuila, Mexico.

BORAGINACEAE

*PECTOCARYA LINEARIS (R. & P.) DC. Collected by us at several localities throughout Pinal Co. and near Hot Springs Junction, at the northern edge of Maricopa Co. In his revision of the North American species of Pectocarya, Ivan M. Johnston[33] does not record the typical form of *P. linearis*

[32] Woodson, R. E., Jr. Studies in the Apocynaceae, III. A monograph of the genus Amsonia. Ann. Missouri Bot. Garden **15**: 379–434. 1928.

[33] Johnston, I. M. Studies in the Boraginaceae, II. (Contr. Gray Herb. **70**: 3–55. 1924), pp. 36 and 39. In the publication cited, *P. linearis* is referred to *P. gracilis* (R. & P.)

as occurring in Arizona, all North American specimens cited by him being from California and the neighboring islands.

VERBENACEAE

*LANTANA CAMARA L. Collected by Kearney, Harrison, and Peebles in 1926 along a large "wash" near Sells (formerly Indian Oasis) Pima Co., where it appeared to be well established. The conditions under which the plants were growing preclude the idea that they were introduced by man, although *L. camara* is often cultivated as an ornamental. Migrating birds may have brought the seeds from some locality in Mexico, since it occurs in nearly all parts of that country. It is found also in the southeastern United States from Georgia to southern Texas. Ours was apparently the first collection of this species in Arizona.

BOUCHEA PRISMATICA (Jacq.) Kuntz. (*B. ehrenbergii* Cham.). This plant, although previously known as occurring in Arizona, is rare in that state and is found only very near the Mexican border. We have collected it, one or two individuals at a time, in the Chiricahua and Huachuca Mts., Cochise Co., and near Nogales, Santa Cruz Co. Our specimens belong to var. *brevirostra* Grenzeb., the range of which, as given by Grenzebach,[34] is New Mexico to Salvador.

MENTHACEAE

*ISANTHUS BRACHIATUS (L.) B. S. P. This plant is widely distributed in the eastern United States, ranging from Quebec and Ontario to Minnesota, Georgia, and central Texas. Its occurrence in Arizona, but apparently not in New Mexico, therefore parallels the interrupted distribution of *Crotalaria sagittalis* and of *Clitoria mariana*. Collected by Harrison in the White Mts. in 1927, and previously in the Mogollon region by C. A. Purpus.

*SALVIA AETHIOPIS L.[35] Abundant at roadsides and in pastures near Kirkland, south of Prescott, where it was collected by Kearney, Harrison, and Peebles in 1926. This seems to be the second record of the establishment of this Old World species anywhere in the United States, the only other locality known to the writer being at Lakeview, Oregon, where it was collected by A. N. Steward in 1920.

SALVIA CONFINIS Fernald. This apparently rare shrub was collected by Peebles and Loomis near Patagonia, Santa Cruz Co., in 1930. The only other stations in Arizona where it occurs, so far as the writer knows, are Fort Huachuca (the type locality) and Lowell, both in Cochise Co. It is found also in Sonora, Mexico.

SALVIA MOHAVENSIS Greene. Collected by Harrison and Peebles in the Sierra Estrella, Maricopa Co., in 1928. This station extends the known range considerably to the east, the only previous collection in Arizona, so far as the writer knows, having been at Chemehuevis Mountain in Mohave Co., by M. E. Jones. The type locality is in the Mohave Desert, California. The species has also been collected by D. T. MacDougal at Pinacate, northwestern Sonora.[36]

Johnst., but Dr. Johnston has since concluded that this name is untenable. Our specimens of *Pectocarya* were identified by him.

[34] Ann. Mo. Bot. Garden **13**: 80, 81. 1926.

[35] Identified by P. C. Standley.

[36] P. A. Munz in Bull. So. Calif. Acad. Sci. **26**: 23. 1927.

SOLANACEAE

*LYCIUM MACRODON Gray. The occurrence of this species in Arizona does not seem to have been definitely recorded, although it is not unlikely that the type was collected there rather than in California or Nevada. It is widely distributed and fairly common in Pinal County, where it was collected by David Griffiths, W. F. Gilman, Alice Eastwood, and subsequently by our group. It was collected also at the eastern base of the Tinajas Altas Mts., Yuma Co., by Kearney and Harrison in 1930. This species occurs also in Sonora, Mexico. The peculiar bony fruit, somewhat resembling that of *L. cooperi* Gray, was collected in a mature condition at Sacaton by Peebles in 1930, apparently for the first time.

*LYCIUM PARISHII Gray (*L. pringlei* Gray). Collected at Mohawk, Yuma Co., by Kearney, Harrison, and Peebles in 1927, and at several other localities in Yuma County and between Casa Grande and Gila Bend (in Pinal or Maricopa Co.) by Kearney and Harrison in 1930. It had previously been collected by E. Palmer on the Williams Mountains in southern Mohave Co., and by David Griffiths on the Papago Reservation in Pima Co., so the species evidently ranges pretty well throughout the southwestern part of the state. It occurs also in southern California and in northern Sonora.[37]

SARACHA SESSILIS Greene. This apparently rare plant, previously known only from the Chiricahua and Huachuca Mts., Cochise Co., was collected in Baboquivari Canyon, Pima Co., by Peebles in 1925 and near Nogales, Santa Cruz Co., by Kearney, Harrison, and Peebles in 1928, thus extending the known range considerably westward. Mr. C. V. Morton of the U. S. National Herbarium informs the writer that he regards *S. sessilis* as not specifically distinct from *S. edulis* (Schlecht.) Thellung, a species of wide distribution in Mexico.

CAPSICUM BACCATUM L. Collected by Harrison and Peebles in Baboquivari Canyon, Pima Co., in 1925. The known range of the species is Florida, southern Texas, and southern Arizona, southward to South America. It seems to be absent in New Mexico and very rare in Arizona.

**SOLANUM DEFLEXUM Greenm. Collected in the Baboquivari Mts., Pima Co., by Harrison in 1927, and by Kearney, Harrison and Peebles near Nogales, Santa Cruz Co., in 1928, both stations being very near the Mexican boundary. Our specimens correspond well with Greenman's description[38] except in having shorter pedicels and a smaller corolla. This species is widely distributed in southern Mexico, as far north as Sinaloa, and in Central America, apparently occurring also in Lower California. It does not seem to have been reported previously as occurring in Arizona or even close to the border in Mexico. As the fruits are fleshy, transportation of the seeds by birds migrating northward seems not improbable.

*SOLANUM HETERODOXUM Dunal. Collected near Kirkland, south of Prescott, Yavapai Co., by Kearney, in 1930, apparently for the first time in Arizona. The plant is well established and is abundant at roadsides in this locality. The Arizona specimens are of the small-flowered form (*S. novomexicanum* Bartlett). *Solanum heterodoxum* occurs also in New Mexico, western Texas, and Mexico.

*NICOTIANA CLEVELANDI Gray. Collected by Kearney near Wellton in 1927 and by Kearney and Harrison near the eastern edge of Yuma County in

[37] All of these specimens were identified by C. L. Hitchcock of the Missouri Botanical Garden, who has concluded that *L. parishii* and *L. pringlei* are not distinct species.

[38] Proc. Am. Acad. Sci. **32**: 301. 1897.

1930. Apparently not previously known as occurring outside of southern California.

SCROPHULARIACEAE

ANTIRRHINUM CYATHIFERUM Benth. (*A. chytrospermum* Gray). This species, apparently rather rare in Arizona, has been collected by Peebles and Loomis on Picacho Peak and on the San Tan Mts., both localities being in Pinal County. It prefers partly shaded situations at the base of cliffs. These collections extend the known range considerably eastward, the only previously recorded locality in Arizona being Ehrenberg on the Colorado River in Yuma Co. This species occurs also in Lower California and Sonora.

MAURANDYA ACERIFOLIA Pennell. Discovered in Fish Creek Canyon, at the eastern end of Maricopa County, by Peebles in 1928.[39]

PENTSTEMON MICROPHYLLUS Gray. Shrubby, with a short and wide corolla of a clear yellow color, belonging to a section of the genus (Fruticosi) that is otherwise confined to California and Lower California. The type locality is on the Williams River in western Arizona, but we have collected it at several localities as far east as southern Gila County, between Winkelman and Globe.

ACANTHACEAE

BELOPERONE CALIFORNICA Benth. This showy, scarlet-flowered plant, very attractive to hummingbirds, is locally abundant on rocky mountain sides in southern Arizona. Our collections have extended the known range eastward as far as the Superstition and Picacho Mountains, in Pinal County. The range as now known is from Lower California, Sonora, and Sinaloa to southern California and northeastward to about latitude 33.5 and longitude 111.5 in Arizona.

RUBIACEAE

*GALIUM PILOSUM Ait.[40] Collected by Kearney, Harrison, and Peebles in 1927 in rich woods on Mt. Graham, Graham Co., where it grew with *Circaea pacifica*. The discovery of this species in southeastern Arizona gives it an interrupted range similar to those of *Crotalaria sagittalis*, *Clitoria mariana*, and *Isanthus brachiatus*, as it was not previously known to occur farther to the southwest than central Texas. Our specimens have broader and thinner leaves than is usual in *G. pilosum*, but according to Mr. Standley, in a letter to the writer, they "agree very well with shade forms of this species from the Chicago region. . . . . I do not see how it is possible to distinguish the Arizona material, even varietally."

*GALIUM SPURIUM L. (*G. vaillantii* DC.).[41] Collected in Devils Canyon, Pinal Co., by Kearney Harrison, and Peebles, in 1928. This European species, naturalized in many parts of the United States, seems not to have been reported previously as occurring in Arizona.

CAPRIFOLIACEAE

LONICERA INTERRUPTA Benth. This is another plant of the mountains of California that reappears in south-central Arizona, having been collected by Harrison and Peebles in 1926 in Devils Canyon, Pinal Co., where it is fairly abundant. It had been collected previously in the Santa Catalina Mts. by Pringle and Lemmon and in the Pinal Mts. by Jones.

[39] Pennell, Francis W. A new Maurandya from Arizona. Journ. Wash. Acad. Sci. 19: 69, 70. 1929.

[40] Identified by P. C. Standley.

[41] Identified by P. C. Standley.

LOBELIACEAE

*NEMACLADUS LONGIFLORUS Gray.[42] Collected in sandy soil at a roadside between Tucson and Ajo, Pima Co., by Kearney, Harrison, and Peebles, in 1927. In a letter to the writer Dr. Munz states that ours is the first collection of this species in Arizona known to him, and adds: "There is some question as to whether *Nemacladus longiflorus* might not be divided so as to recognize a desert variety. Your plant matches exactly some four or five collections from the western edge of the Colorado Desert in California. These are all smaller than the species ordinarily is. Your plant is another example of a group of species that is found primarily on the California coast but straggle occasionally into the Tucson region."

ASTERACEAE[43]

SOLIDAGO WRIGHTII ADENOPHORA Blake. The type of this variety was collected by Harrison in the Santa Catalina Mts., Pima Co., in 1926, but the same form had been collected previously at other localities in southern Arizona and New Mexico.[44]

ERIGERON OXYPHYLLUS Greene. Collected in the Sierra Estrella, Maricopa Co., by Peebles and Harrison in 1928. This represents a considerable southeastward extension of the range, the species having been known previously only from Yucca, Mohave Co., Arizona, where the type was collected by M. E. Jones. The stems are woody towards the base.

**GNAPHALIUM PRINGLEI Gray. Collected by Peebles in Baboquivari Canyon, Pima Co., in 1925, this being apparently the first collection in Arizona and in the United States. Collected subsequently by Harrison and Peebles in the Santa Rita Mts. (Pima or Santa Cruz Co.) and by Kearney, Harrison, and Peebles in the Huachuca Mts., Cochise Co. The species was known previously from Chihuahua and San Luis Potosí, Mexico.

NOCCA DECIPIENS (Hemsl.) Kuntze. This plant is apparently very rare in Arizona and confined to the immediate vicinity of the Mexican boundary. It was collected by F. A. Thackery at the western base of the Baboquivari range, Pima Co., in 1926, and had been collected previously in Pima Co. by E. A. Mearns. The known range of the species is from southern Arizona to Chihuahua, Sonora and Jalisco, Mexico.

*XANTHIUM SPINOSUM L. Well established in the vicinity of Prescott, Yavapai Co., where it was collected first by B. E. Fernow. Naturalized from tropical America.

TITHONIA THURBERI Gray. Collected in Baboquivari Canyon, Pima Co., by Kearney in 1925 and in the vicinity of Nogales, Santa Cruz Co., by Harrison and Peebles in 1927. These are the first collections of any member of the genus in Arizona and in the United States.[45] *T. thurberi* was known hitherto only from northern Sonora.

VIGUIERA OVALIS Blake. Collected in the Chiricahua Mts., Cochise Co., by Kearney and Harrison in 1929, this being the third time the species has been collected and the second collection in Arizona (previously by J. G. Lemmon, without record of the locality). It is known only from southeastern Arizona and southern New Mexico.

[42] Identified by Philip A. Munz.

[43] Identified by S. F. Blake, to whom the writer is indebted for much of the information in the following notes.

[44] S. F. Blake in Journ. Wash. Acad. Sci. 19: 269. 1929.

[45] S. F. Blake in Proc. Biol. Soc. Wash. 39: 145. 1926.

PERITYLE CILIATA (Dewey) Rydb. (*Laphamia ciliata* Dewey). Rare but widely distributed in Arizona. Collected near Prescott, Yavapai Co., by Kearney in 1926 and previously by D. T. MacDougal near Pine, Gila Co., by J. W. Toumey in the Tucson Mts., Pima Co. and by J. B. Leiberg on Elden Mesa, near San Francisco Mt., Coconino Co.

LAPHAMIA GILENSIS Jones. This plant, known previously only from the type collection by M. E. Jones on the Gila River,[46] was collected in Devils Canyon in Pinal Co. by Harrison in 1926 and subsequently in Fish Creek Canyon at the eastern end of Maricopa Co., by Peebles, Harrison, and Kearney.

HYMENOTHRIX LOOMISII Blake. The type was collected by Loomis near Ashfork, Yavapai Co., in 1926, although the species had previously been obtained by several other collectors in northern and northwestern Arizona.[46] In 1930, *H. Loomisii* was found by us growing in considerable abundance 30 miles south of Prescott, in Yavapai Co., this station being the southernmost yet known.

PLUMMERA AMBIGENS Blake. The type and only known collection of this species was on the lower slopes of Mt. Graham, Graham Co., by Kearney, Harrison, and Peebles in 1927.[47] It occurs abundantly on a dry, unshaded slope at that locality.

**PECTIS URCEOLATA (Fernald) Rydb. (*P. prostrata* Cav. var. *urceolata* Fernald). Collected near Nogales, Santa Cruz Co., by Harrison and Peebles in 1927, and considerably farther north, in the Sierra Ancha, Gila Co., by Kearney and Harrison in 1928. It had been collected previously by E. A. Mearns south of Bisbee, Cochise Co., but apparently the occurrence of this species in Arizona and in the United States has not hitherto been recorded. *P. urceolata* ranges from southern Arizona through Sonora and Chihuahua to El Salvador.

PALEONTOLOGY.—*The mastodon of Thomas Jefferson.*[1]

MARGARET R. HITCHCOCK, University of Virginia. (Communicated by C. WYTHE COOKE.)

The upper and lower jaw bones of a *Mastodon americanus* (Leidy) do not, in themselves, constitute a rare fossil. The species has been well described by writers for many years, and the work on the Proboscidea, which is in progress, under the direction of Dr. Osborn at the American Museum of Natural History, would, of course, cover many descriptions of such remains. The bones described below, however, are interesting for two reasons, first, because of the historical significance attached to them, and second, because of an unusual position of the teeth in the lower right jaw, which resulted in a real malformation.

The fact that Thomas Jefferson, in addition to being a law giver, architect, educator, and inventor, was also a paleontologist, has been

[46] S. F. Blake in Proc. Biol. Soc. Wash. **40**: 49, 50. 1927.

[47] S. F. Blake in Journ. Wash. Acad. Sci. **19**: 276–278. 1929.

[1] Received January 13, 1931.

brought to our attention again quite recently by Dr. Osborn. In an address delivered in Washington in 1929, Dr. Osborn[2] brought out the keenness of Jefferson's interest in paleontology, and the persistency with which he pursued his studies. From his letters we can see that

Fig. 1.—View looking down on the lower mandible, showing the differences in the two sides.

interest marching along side by side with the affairs of the nation, for on the same day letters were written dealing with fossil remains, and others with national policies. A proof of this avocation of his rests

[2] H. F. Osborn. *Thomas Jefferson, the pioneer in American paleontology.* Science, n.s., **69**: 710–713. 1929.

at the University of Virginia which he planned and founded. In the museum there are the jaw bones of a mastodon which were probably given to the School of Natural Science by Jefferson himself.

There is some question as to the locality from which these bones were collected, and by whom collected. Tradition has it that they were collected by Thomas Jefferson. It seems unnatural, however, for a man who had so great an interest in the study of such fossils, and who wrote so many letters on the subject, not to have mentioned in some of these an event of such importance as his own personal collection of so

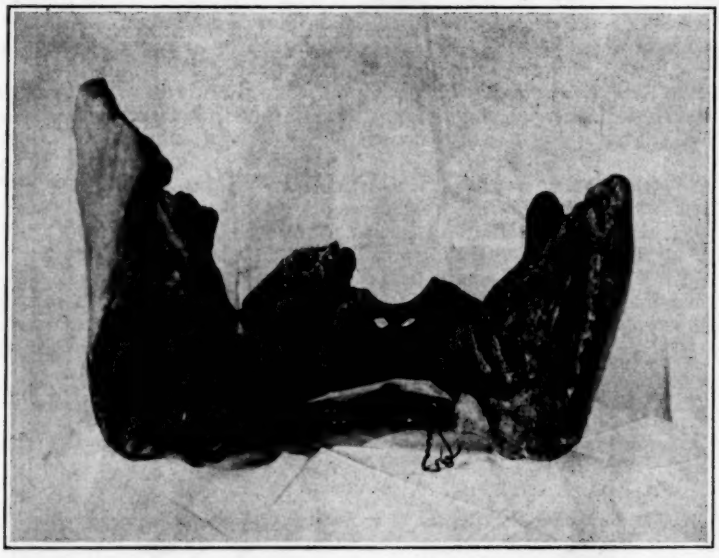

Fig. 2.—Lower mandible from the rear, showing adjustment caused by the impacted tooth at right (as figured).

great a find. In a letter to Dr. Caspar Wistar dated February 25, 1807, he writes, ". . . . Being acquainted with Mr. Ross, proprietor of this big bone lick, I wrote him for permission to search for such particular bones as the society might desire, and I expect to receive it in a few days. Captain Clarke (companion of Captain Lewis) who is now here, agrees, as he passes through that country, to stop at the lick, employ labourers and superintend the search at my expense, not that of the society, and to send me on the specific bones wanted, without further trespassing on the deposit. . . . . But send me the list if you please without delay, as Captain Clarke returns in a few days, and

we should lose the opportunity."[3] Later in the same year there is a letter to General George Rogers Clarke, thanking him for sending on the bones which have been collected, and another to Dr. Wistar in which the list of bones is again discussed, and in which Jefferson's cabinet at Monticello is mentioned, as a few of the bones were especially gathered for it.[4] Whether the jaws, which are in the museum at the University of Virginia are some of those collected by the Clarke brothers, or had been owned by Jefferson before that time, we may be fairly certain that they were a part of his collection at Monticello, for George Tichnor wrote from there of the "os frontis" of a "mammoth" in the "cabinet," and that they were given from there to the University, where they are another evidence of his interest in the natural sciences.

The upper jaw with a portion of the skull is probably the better preserved of the two members as far as teeth are concerned, but in the

TABLE 1.—DIMENSIONS OF THE LOWER JAW

	Left side	Right side
	cm.	cm.
Length of jaw	65	68
Width of jaw in front of front molar	8	13
Width of jaw behind first molar	15	19
Length from the inside of the symphysis to the beginning of the coronoid process	35	38
Width at the beginning of the coronoid process	14	14
Height of the coronoid process from the top to the jaw bone.	14	13[a]

[a] The original length of the broken process must have been a little greater than 16 c m

consideration of the bony structure as a whole, it is a less complete specimen. All of the more porous parts of the upper portion of the skull have been broken off, so that only the traces of the air cells have been left, and only the base of the brain cavity, still showing, however, the processes which divide these. Nevertheless the fine porosity of the bones is well shown and an excellent idea of the general structure of the skull may be obtained. The length of this piece is about 50 cm., while the width is between 35 and 40 cm.; there are two molars in place on each side. Of these the front ones are the most worn, and so well worn that there are no cusps, but ridges, while only the front two cusps are worn on the back ones. All the transition stages can be seen from the well worn in front to the perfect cones in back, which must have

[3] The writings of Thomas Jefferson. 9: 158. 1907.
[4] The writings of Thomas Jefferson. 9: 403, 405. 1907.

been still covered by the gums. On the right side, the bony process in front has been broken off until it shows the long curved roots of the first molar. The right side seems to have had more use, as the teeth are more worn down than those on the left side, and this seems to be connected with a slight warping of the upper jaw, which might otherwise have been considered a result of the replacement accompanying fossilization, but which seems to correspond with a malformation of the lower mandible, which does away with that conjecture.

As the lower jaw is not symmetrical and has been broken, it presents several problems. The break occurs just to the right of the symphysis but owing to the recency of the mending of this, very probably within the last twenty years, it would seem to be surely one complete lower jaw, and not the patched up fragments of the jaws of two different individuals. It seems necessary to decide this fact because of the lack of similarity of the two sides, in several ways (see figures 1 and 2). This difference is, perhaps, best brought out in a comparison of the measurements taken of the two sides, listed in Table 1.

It is interesting to note that the actual difference in length in the two jaws is only 3 cm., as the apparent difference is so great. This is most probably due to the more massive appearance of the left side, which is also the shorter side, and this tends to magnify the inequality. This shortness of the left side persists in all parts of the jaw, except in the tooth sockets, which seem to be the same size in all dimensions as those on the right. This, of course, has the effect of making them appear much larger in proportion. The vertical thickness of the two sides is so nearly the same that no measurements in this direction were taken until the coronoid process was reached. The shape of the two sides of the jaws differs greatly. The curve from the symphysis on the left side is quite abrupt, going into a fairly straight line almost immediately, while on the right side the curve is slower and continues to the coronoid process, where the bone narrows on both sides. This narrowing occurs to a certain degree in both sides, but on the right side it narrows quickly and leaves a decided angle on the inside of the jaw, while on the left side there is a slow and more rounded narrowing (see figures 1 and 2). The width of the two sides, just in front of this process and behind the second molar, is the same on the two sides. This is as it should be, but in this case, where the entire left side is smaller, it makes this side proportionately too broad at that spot. The massive appearance above mentioned is due to this swelling and the lack of angularity of curve behind it.

The height of the coronoid process varies on the two sides. The

right side of the specimen has been broken at this point, but even in that state, the right side measures 13 cm. while the left measures 14 cm., and the necessary additional height to complete the process on the right side would make that side at least measure up to 16 cm. This is the only great difference in vertical height in the two sides.

The teeth of the lower mandible are not all present, but those still in place are in a state of good preservation, and again show the different stages of wear, and are, in general, less worn than those of the upper mandible. The teeth of the right side are two in number, molars of three and five ridges or cones. The first molar, three-coned, is slightly worn down, the front cone as is natural being the most worn, and the second, the five-coned tooth, has no sign of wear on the back two cones. Even the slight depression into two cusps on the last cone of this tooth shows perfectly. These teeth are in place and there is apparently no room for any others between the last one and the coronoid process, and no spot in this process which is thick enough to conceal another later molar. The teeth of the left jaw which correspond to those of the right jaw are missing. These have very evidently been lost since the specimen was found. Perhaps they were given to other museums by Jefferson in the early days at Monticello, or they may have been misplaced since becoming the property of the University of Virginia. The sockets in which the roots of these teeth rested are perfectly clear and clean of any foreign material, which is not true of some of the air cells and cavities in the skull, which still contain small pebbles and sand, and have been broken and chipped away. These sockets show that they originally contained first a three-coned tooth, and second a five-coned tooth, exactly corresponding to the two on the other side, though they seem to have been placed a little farther forward on the jaw bone nearer the symphysis than those on the right side. In addition to these, there is, as a third tooth, a large molar, the first two cones of which are now visible in front of the coronoid process, the last three of which are beneath this and only visible from the inside of the jaw, where the bone has been broken away (see figure 2). This molar is as large as the one on the right side, which would correspond to the original second tooth on the left jaw, and is in perfect condition, not worn at all; in fact, it could never have appeared above the gum, as the top of the cones is still below the original surface of the slope leading from the jaw bone proper to the coronoid process. The bone of the process above it is much thicker through than the corresponding bone of the left jaw, and seems to have thickened and changed the angle of growth in order to accommodate this peculiar tooth. If the

curve of the connection between the jaw bone proper and the process were not broken, it would be possible to see how completely surrounded this tooth is by bone. As it is, a reconstruction of this material can be postulated and the line of the original bony material drawn which would cut the tooth at such an angle, that it would be impossible for the tooth ever to have appeared above the surface, either in a vertical or in an inclined horizontal direction. In the latter and only possible direction the bone which has recently been broken off would have intercepted and broken off the second cone of the tooth, which, of course, would have stopped its progress. This tooth, then, seems to be one which is completely misplaced, and which, due to this, has caused a thickening and changing of the shape of the process in which it is found. The changes in bone building necessary to accommodate this tooth would lower the coronoid process, causing the difference in vertical height between the process on the left jaw and the corresponding process on the right jaw. This difference probably amounted to as much as 2 cm., at least, and this, with the greater thickness, would throw the balance of the jaw to an entirely different center from the normal one of the right jaw. In this way may be explained the difference in length of the two jaws as well as their great difference in shape.

In addition to this, it is interesting to note that the upper mandible seems to be slightly warped and one-sided. As mentioned above, this seems to be a real malformation, and not an effect of fossilization, and appears to be an attempt of the upper mandible to conform to the distortion of the left lower jaw, in order to give as good occlusion as possible. In this way the occurrence of one tooth in the wrong position has caused the warping and malforming of the entire head of the mastodon.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

PHILOSOPHICAL SOCIETY

1011TH MEETING

The 1011th meeting was held in the Cosmos Club Auditorium on November 8, 1930, President LAMBERT presiding. The program consisted of six reports on various phases of the meeting of the International Union of Geodesy and Geophysics held in Stockholm, Sweden on August 15–23, 1930. The discussion of the papers was deferred until the end of the program.

W. BOWIE: *An outline of the organization and purpose of the Union, and Proceedings of the Section of Geodesy.*—The International Geodetic and Geophysical Union is one of the branches of the International Research Council.

At stated periods delegates from the different countries meet under the auspices of this Union to confer on questions of geodesy and of geophysics which are world wide in their extent, and to lay out comprehensive plans of attack on these problems.

Before the world war, there were a number of scientific associations, each of which covered a certain branch of science. These associations either went out of existence during the war or were very much reduced in size and importance. In 1919, the Allied Powers reorganized international scientific work at a meeting in Brussels, Belgium, at which the International Research Council and several of its Unions were formed. Later, other Unions were created.

There are now 38 countries adhering to the International Research Council and the International Geodetic and Geophysical Union. Delegates from 32 of these countries were present at the Stockholm meeting, and also guests from Germany, Austria, Latvia, Lithuania and Esthonia. In all, there were about 180 official representatives and 70 invited guests at the meeting. The guests took part in the scientific discussions, but did not vote.

One of the most important things which came before the Union was the revision of the Statutes. The Council and its Unions are, at present, working under what is called a convention which somewhat resembles a treaty among the different countries. This convention will expire on December 31, 1931, when some new arrangement must be provided. The International Research Council has had a committee working on the revision of the present convention and statutes and, according to present advice, the new arrangement will take the form merely of statutes rather than a convention. This will mean that the Council will not be quite so formal as it now is.

The new statutes will use the designation association instead of section for each branch of the Unions. This designation carries more weight and dignity, and the change was unanimously approved. Another change in the statutes relates to the term of office of the President of the Union, who hereafter will hold office only during the period between two general assemblies and will not be eligible for immediate reëlection. Still another change deals with the matter of financial contributions from the adhering countries. The largest of the countries, including the United States, pay annually eight units and, at present, a unit is 900 gold francs. The unit hereafter will be 2000 Swiss francs, and thus the annual contribution from the United States will be slightly more than $3000 in U. S. currency.

The International Geodetic and Geophysical Union embraces 7 associations, as follows: Geodesy, Seismology, Meteorology, Terrestrial Magnetism and Electricity, Oceanography, Volcanology, and Scientific Hydrology.

The Stockholm meeting of the Section of Geodesy was a very successful one. There were approximately 70 delegates and guests present. As usual, national reports from each of the countries represented, giving in some detail its geodetic accomplishments during the preceding three years and including discussions of improvements in methods and instruments and results of scientific research, were received. These reports were all in printed form and the chairmen of the various national delegations simply gave abstracts.

There were 21 standing and special committees, all of which held meetings and reported their findings and recommendations to the Association. A number of resolutions were adopted by the Association relating to recommended arcs of triangulation, gravity observations at sea, etc.

Only one scientific paper was presented, and that was by Dr. F. A. VENING MEINESZ, a member of the Dutch Geodetic Commission. He described his

recent gravity-at-sea work in the waters of the East Indies, during which he established about 235 stations. He has already made an approximate isostatic reduction of these stations, and finds that the East Indies, as a whole, are in isostatic equilibrium but that there are some rather interesting and remarkable local anomalies.

The delegates were unanimous in expressing their admiration of the splendid arrangements which had been made by the local committee, headed by Dr. PLEIJEL. Every facility was afforded the Union and the Associations to carry on their work in the smoothest possible way. The Swedish people are noted for their ability in organizing and handling such meetings as that of the International Geodetic and Geophysical Union. (*Author's abstract.*)

H. H. KIMBALL: *Proceedings of the Section of Meteorology.*—The several commissions of the Section held numerous meetings prior to the convening of the Section, listening to papers, and discussing and amending resolutions that were later presented to the Section for action. In spite of this preliminary work, the Section had not time to properly discuss important questions that came before it.

With a view to remedying this condition the Section, by resolution, limited its future activities to the consideration of meteorological questions that call for collaboration with other branches of geophysics, or that may require discussion by experts before they can be recommended to the Meteorological Organization for consideration in connection with the solution of practical problems.

As illustrating the significance of this resolution, it was noted that there are important relations between the extensions of polar ice and the seasonal character of the weather over large areas. It was suggested to the Meteorological Organization (made up of directors of meteorological services) that more complete data on this subject be collected, especially during the polar year 1932–33. Also, the attention of the Meteorological Organization was invited to the possibility of introducing into the publication of daily observations the data necessary for the calculation of the *entropy of the air*, and of defining *air turbidity* with a view to eventually including it in synoptic wireless issues.

The Section recommended that the Union accept the invitation of the Meteorological Organization to cooperate in organizing and carrying out a second polar year in 1932–1933, and that an effort be made to obtain the active cooperation of governments and scientific institutions.

These are only a few of the subjects passed upon by resolutions, the complete text of which is published in the Monthly Weather Review, August, 1930, **58**: 313–316.

The budget of the Section has to its credit for expenditure during the period of 1930–33, about 365,000 French francs, ($14,600.00). Of this $2,000 is allotted to the Bureau of the Section for its expenses. The rest is distributed among various projects, such as the publication of reports on the exploration of the high atmosphere, the preparation of weather charts of the Northern Hemisphere, the publication of a bibliography of solar radiation, a grant to the POLAR YEAR in the form of a prize for the first model of an automatic meteorological station giving satisfactory results, and to M. GIÂO for experiments in weather forecasting. (*Author's abstract.*)

N. H. HECK: *Proceedings of the Section of Seismology.*—The meeting of the Section of Seismology started off under unusually good conditions. Professor H. H. TURNER of Oxford University as Chairman presented an unusually fine report. He called attention to the great advances being made in seis-

mology in nearly all parts of the earth, but especially in the United States. He also presented the discussion of earthquakes of unusually deep focus, showing that such earthquakes occur around the rim of the Pacific. His theories are of interest because of the apparent conflict of such depth of focus with the principle of isostasy.

Just as the second session was about to start, Professor TURNER leaned forward, put his hand to his forehead and never had a conscious moment, dying three days later. It was necessary, of course, for the meeting to go on and after his removal to the hospital, the various national reports were received, including that for the United States which I presented and which was commended.

The division of the somewhat increased funds was discussed and it was decided to divide them into three parts, one for continuing the international seismological summary at Oxford, another for the work of the Central Bureau at Strasbourg, and the third to finance special investigations or to be held in reserve. Travel time curves and tables of earthquakes were discussed and Dr. MACELWANE agreed to revise his tables and Professor ROTHÉ agreed to publish them on behalf of the International Bureau. A code for international transmission of seismic data was revised.

Special reports and papers of interest included one by Miss LAHMENN of Denmark who gave the results of studies of an earthquake in the Yonga Deep and one in Mexico, these occurring at such distances from Europe as to give results of particular interest in regard to certain phases passing through the core. Dr. IMAMURA presented a very complete discussion of earth tilts in Japan as relating to earthquakes. He showed that after a great earthquake there is for a long time tilting in one direction, then a reversal, and finally, just before a great earthquake, there are very sudden changes in the tilt which serve to give a few hours advance warning. He was able from geological records to apply the theory to early earthquakes long before the period of accurate instrumental observations. Dr. WENNER discussed his torsion seismometer and presented a design for a strong-motion instrument to be used in the central region of a strong earthquake. Dr. MACELWANE described the recent performance of the Wood-Anderson seismometer, an important matter because the presentation of this subject at the Madrid meeting of the Union was unfortunate. He also gave an analysis of the time as obtained from records from important stations throughout the earth and proved that the errors may be much greater than ordinarily assumed. A representative of Portugal called attention to recent monumental work on the geological features of the great Lisbon earthquake. Dr. ROTHÉ gave a memorial address on Dr. WIECHERT, the great German seismologist who died since the last meeting. Dr. ANGENHEISTER, a German seismologist who was present as a guest and Dr. CONRAD of Vienna who was present agreed to publish both addresses in the Beiträge Zur Geophysik.

These were the principal activities though many other matters were discussed.

After the removal of Professor TURNER proceedings were handicapped by the inability of Acting Chairman ODDONE and Secretary ROTHÉ to speak English and interpreters had not been provided as Professor TURNER always performed this function extremely well. The results were very unsatisfactory to the English speaking delegates who comprised about half the number. I was able to understand about 80 per cent, but not enough for intelligent action on important matters. Assurance was given that interpreters will be provided in the future.

In conclusion, I consider the meeting as generally successful. We must have, from time to time, consultation on international issues. At the next meeting the matter of publication must be given more attention. Certain activities now national could well become international and thereby relieve each part of the earth of routine work and thereby make possible special studies which will increase our knowledge. The importance of personal contacts with geophysicists of other countries will undoubtedly be emphasized by the speaker dealing with the general features of the meeting. (*Author's abstract.*)

J. A. FLEMING: *Proceedings of the Section of Electricity and Magnetism.*—Six scheduled and well-attended meetings of the Association of Terrestrial Magnetism and Electricity at Stockholm were held during August 1930, and the Association also took part in four joint sessions one with the Associations of Geodesy and Seismology, one with the Association of Meteorology, and two with the International Scientific Radio Union. The agenda for the meeting held an unusually great number of items, all of which were actively reported upon and discussed despite the comparatively short time available.

Detailed progress reports of magnetic-survey work and investigations were received from twenty countries including three reports from the United States—the Coast and Geodetic Survey, the American Geophysical Union, and the Department of Terrestrial Magnetism of the Carnegie Institution of Washington. Numerous publications relating to these reports were distributed, and one was impressed not only with the amount of useful work in the fields of the Association being done throughout the world but also with the vast amount still to be done.

The report of the special committee on the preparation of a photographic atlas of aurora with type descriptions and instruction for photographic and visual observation was received and approved, and authority was given that copies of the atlas be distributed without charge to observatories and organizations where worth-while auroral observations might be made. Following the report of the special committee on criteria of measures of magnetic activity, the formulas for characterization of days ($HR_H + ZR_Z$)/10,000 or ($NR_N + WR_W + ZR_Z$)/10,000 were adopted, where R represents the absolute daily range of the element indicated for the Greenwich day, and arrangements were proposed that data derived by one or the other formula be published by the International Commission of Terrestrial Magnetism and Electricity in its regular publication of magnetic character of days.

The importance of continuing comparisons of standard electromagnetic instruments of various governments was emphasized, as also the design of portable apparatus of this character. It was agreed that the various suggestions on the subject of a uniform terminology be published for further consideration. The adoption of Greenwich mean time for the publication of magnetic data was referred for further consideration to a special committee. A reporter was appointed to summarize the progress in the studies of theories of terrestrial magnetism.

The importance of standardizing ion counters was emphasized, and the Department of Terrestrial Magnetism of the Carnegie Institution of Washington was appointed as a central office to which matters could be referred pertaining to ion counters for compilation, discussion, and determination of the standards. Following discussion of the electric field of the atmosphere, it was agreed that tabulations to determine electric character of day might best be limited to electrically calm days.

Among the communications of particular interest in atmospheric elec-

tricity was one on the direct recording of air-earth current at the Kew Observatory by the C.T.R. WILSON method; such records may be compared with indirect determination through the records also being made of the conductivity and potential gradient of the atmosphere.

Considerable attention was given economic aspects of the Association's activities. These included the application of geophysical principles to the investigation of the earth's crust; it was agreed that a committee be appointed jointly by the associations of Seismology, Geodesy, and Terrestrial Magnetism and Electricity to collaborate in the solution of problems in geology through geophysics. Another economic aspect was the development of machine methods to facilitate the complex computations and compilations required in studying the numerous data accumulated by many observatories. An example of this was brought out in the report of a special committee on international collaboration for the advancement of studies of the influences of the moon on geophysical phenomena developing a plan for the assembling of data making use of Hollerith methods for compilations. The report was favorably considered and satisfaction expressed that a practical trial of the application of such a method was in prospect, thus paving the way for a definite proposal for international cooperation later.

Much attention was also given the proposal for the Jubilee Polar Year of 1932–33 of the Polar Commission of the International Meteorological Committee, and the desirability of adherence in the undertaking of all governments was stressed. Following a joint meeting of the Associations of Meteorology and of Terrestrial Magnetism and Electricity and the deliberations of a special joint committee, the following resolution was prepared for and later adopted by the General Assembly:

"The Union accepts the invitation of the International Meteorological Committee to cooperate in organizing and carrying out a second Polar Year with a similar object to that of the first Polar Year 1882–1883, and appoints the following Commission for this purpose: STÖRMER (*Chairman*), CHAPMAN, LA COUR, MAURAIN, and WEHRLÉ."

Other resolutions proposed by the joint committee were adopted by the Association. One emphasizes the very great importance for the advancement of geophysical science for the Polar Year as planned and its approval that the observations should not be confined only to polar regions. The Association, realizing the desirability that all cameras, plates, and spectroscopes used in the observations of the aurora should be of equal sensitivity, voted 15,000 gold francs for the provision of instruments of a standard type. It was further unanimously resolved that all observations should be reduced according to an agreed plan and that the Commission for the Polar Year should consider the best method for making the detailed results available for all those interested, further suggesting that all published volumes should be put on sale and that the various associations of the Union should subscribe for a number of copies.

Regarding possible overlapping of the work being done by the Association of Terrestrial Magnetism and Electricity and the Commission on Terrestrial Magnetism and Electricity of the International Meteorological Committee, it was unanimously agreed upon that it is not necessary to set a rigorous definition of the domain of each organization, as no difficulties have been met with in practice and no unnecessary duplications have been encountered, and as the respective officers can continue their effective cooperation in avoiding these.

The importance of study of the correlation of the reception of wireless

signals and geophysical phenomena was referred to two joint meetings with the International Scientific Radio Union, the Association expressing itself as approving any program assuring the broadcasting of cosmic phenomena to facilitate the study of correlations concerning radio communication and the magnetic and electric condition of the Earth.

Recognizing the vital need of a better world-wide distribution of observatories, especially in the southern hemisphere, a special committee was appointed to consider existing and desirable distribution of magnetic and electric observatories and to consider plans for better coordination of work and publications of existing observatories. The economic impossibility of realizing more than a limited number of observatories and the reports on secular-variation investigations submitted stressed the need of systematic field work, and a special committee was appointed to plan and to accomplish means to secure through cooperation of interested governmental and private organizations well-distributed secular-variation data. In connection with this subject, appreciation of and generous comment was expressed on all sides on the magnetic and electric work at sea secured by the *Carnegie* together with expressions of regret that the work that vessel and her commander and staff had so well done could not have been continued as planned.

The election of officers for the period to the next Assembly at Lisbon in 1933 resulted as follows: J. A. FLEMING, United States, *President;* CARLHEIM-GYLLENSKÖLD, Sweden, *Vice-President;* CH. MAURAIN, France, *Secretary* and *Director of Central Bureau.* The Executive Committee of the Association, besides these officers, includes A. CRICHTON MITCHELL of Great Britain, J. JAUMOTTE of Belgium, D. LA COUR of Denmark, L. PALAZZO of Italy, and A. TANAKADATE of Japan. (*Author's abstract.*)

G. W. LITTLEHALES: *Proceedings of the Section of Oceanography.*—The significant events of the meeting of the International Section of Oceanography at Stockholm were on the administrative side—not that there were no important reports and communications brought and deliberated upon.

The Spaniards, in relation to the project for connecting Spain and Morocco by tunneling under the bed of the intervening waters, presented details of their oceanographical operations in the Strait of Gibraltar, portraying the submarine conformation of the Strait and the hydrological mechanism of its waters; the International Hydrographic Bureau at Monaco, through the President of its Directing Committee, submitted an account of the considerations of the Bureau, accompanied by an appeal for advice, in relation to the transaction with the Oceanographical Museum of Monaco by which the Bureau had accepted the charge of the upkeep of the *Carte générale bathymétrique des océans;* Dr. VENING MEINESZ furnished a discussion of the facts of observation resulting from his campaigns for measuring the distribution of the intensity of gravity on the ocean; the British delegation brought a mathematical discussion of the action of the tides in narrow channels; the Department of Terrestrial Magnetism of the Carnegie Institution of Washington presented, in a series of reports of unexcelled form and substance, the oceanographical results of the last cruise of the CARNEGIE, and, in addition, the American delegation presented a comprehensive report of developments in oceanography for the years intervening since the meeting of the International Section of Oceanography in 1927.

But to return to the administrative side: When the International Research Council was established at Brussels in 1919, among the unions that were formed to compose the institution was the Union of Geodesy and Geophysics, in which provision was made for a Section of Physical Oceanography

—the intended place for Biological Oceanography being in the contemplated Union of the Biological Sciences.

Inasmuch as the Union of Biological Sciences did not develop as intended, the aspiration soon manifested itself to have formed a separate Union of Oceanography which should include both physical oceanography and biological oceanography. This proposal was advanced before the International Research Council, but the Council did not change the Statute as originally framed.

Biological oceanographers have, however, largely adhered to the International Section of Oceanography, and the Section has been under the administration of biological oceanographers from the time of the meeting of the International Union of Geodesy and Geophysics at Rome in 1922 until the election, which was brought about at Stockholm, which resulted in the installation of a physical oceanographer in the Chairmanship and also a physical oceanographer in the Secretaryship. (*Author's abstract.*)

F. WENNER: *Impressions of the excursions and entertainments.*—The entertainments and excursions arranged for the delegates included a banquet at the City Hall given by the City of Stockholm; an excursion on Lake Mälaren to Mariefred, with a visit to the old Gripsholm Royal Castle, and luncheon; an excursion into the archipelago of Stockholm and luncheon; reception by the Crown Prince and Princess at the Royal Palace; visit to the University of Uppsala; banquet given by the Swedish Organization Committee; three excursions arranged especially for the ladies at times when the delegates were supposed to be attending meetings, and two excursions after the close of the meetings, one to northern Sweden and one to Göteborg via the Trollhättan Canal. In addition there were many privately arranged luncheons, dinners, and other social gatherings, visits to the Swedish Geological Survey, the Magnetic Laboratory, etc. The entertainments and excursions were for the most part well planned so that they constituted an exceptional opportunity for the formation of acquaintances and friendships among the delegates and their accompanying ladies. They also furnished numerous opportunities for the discussion of questions arising in the meetings. Finally they served as a means for giving us a better understanding of the Swedish people and their customs than otherwise would have been possible in so short a time.

While the excursions and entertainments were most profitable as well as enjoyable, of those in which I participated the one most worth while was the excursion to Göteborg, which is on the west coast. This was planned by Mrs. JENSEN of Göteborg and conducted by Major RICHARD SMEDBERG of Stockholm and Mrs. JENSEN assisting. The first day was spent in tramping, under the guidance of Civil Engineer WILLIAM MOBERG through a trackless country in the neighborhood of Degerfors, which is in the south-central part. The second day was spent on the Canal and in visiting the locks and various hydroelectric plants along the route, points of interest being discussed by Professor Baron STEN DE GEER. The third day was spent in seeing points of interest in and in the vicinity of Göteborg under the guidance of Baron STEN DE GEER. In the evening we were guests at a dinner given by the Governor of the Province of Göteborg and Mrs. VON SYDOW. While this dinner was not as elaborate as others, evening dress with decorations was specified. By that time the party of about 35 representing eleven different nations were fairly well acquainted, considering the language difficulty, there being seven languages represented. Further, for this group this was the final formal social function of the meeting, so someone from each of the countries gave a short

talk and toast to our hosts. The fourth day we were guests of the Swedish Hydrographic and Biological Commission aboard the Coast Guard vessel SKAGERAK into the Göteborg archipelago. When the party broke up on the afternoon of the fourth day, we were as happy a group of people as I had ever seen. The various difficulties which had been continually coming up in the meeting had largely disappeared and we parted with a feeling of mutual understanding and of real friendship towards each other. The friendships formed and the understandings reached on this excursion will no doubt have a marked effect upon the progress of geophysics. (*Author's abstract.*)

The report as a whole was discussed by Messrs. CRITTENDEN, MEYER, and HUMPHREYS.

OSCAR S. ADAMS, *Recording Secretary*

BIOLOGICAL SOCIETY

751ST MEETING

The 751st meeting was held in the new assembly hall of the Cosmos Club October 18, 1930 at 8.10 p.m. with President WETMORE in the chair and 38 persons present.

ALEXANDER WETMORE mentioned the observation of a flock of Forster Tern in Maryland near the mouth of the Potomac on September 28, 1930. One specimen was collected.

HOWARD BALL announced his capture of a specimen of Baird Sandpiper that day at Alexander Island, Virginia.

S. F. BLAKE presented a note on the domestic turkey made during the past summer in Maryland. While driving on the highway to Point Lookout, a female turkey was observed in the road brooding a dead young one which had evidently been run over by an automobile a short time before. The turkey stood up, took the head of the young one in her beak, and shook it as though trying to arouse it. At the approach of another automobile she left it and walked across the road.

The regular program was as follows:

ALEXANDER WETMORE: *The International Ornithological Congress.*—The speaker gave an interesting account of this Congress held at Amsterdam in June 1930, at which about 300 delegates were present. Several excursions were made to points of ornithological interest. The next meeting will be held in England in 1934.

L. M. ESTEBROOKE: *The Inter-American Conference on Agriculture.*—The speaker outlined the subjects discussed at the First Inter-American Conference on Agriculture held in Washington in September, which covered the whole field of agriculture and marketing, and spoke of some of the more important resolutions presented.

WATSON DAVIS: *Recent Biological Literature.*—The speaker mentioned briefly some recently announced scientific discoveries and exhibited several lately published books. He also commented on several recently exhibited fraudulent moving pictures purporting to show African wild life.

A. S. HITCHCOCK: *Nomenclature at the International Botanical Congress.*—The speaker presented an account of some of the results in nomenclature at the International Congress held in Cambridge, England, last August, with an account of the preliminary work leading up to the Congress.

752D MEETING

The 752d meeting was held in the new assembly hall of the Cosmos Club on November 1, 1930 at 8.10 p.m. with President WETMORE in the chair and 78 persons present. New members elected: A. V. SMITH, Mrs. VIOLA S. SNYDER.

T. S. PALMER gave an account of the recent meeting of the American Ornithologists' Union at Salem, Massachusetts, and that of the National Association of Audubon Societies at New York, and the coming annual trip of the local Audubon Society to the Zoological Park. He also mentioned that the strict embargo on the importation of parrots has now been modified to permit the entrance of certain species.

The regular program was as follows:

W. L. SCHMITT: *Exhibition of a rare isopod* (illustrated).—The speaker exhibited specimens of the giant isopod, *Bathynomus giganteus*, eight specimens of which were captured by an expedition of which he was a member last summer near the Dry Tortugas, and gave an account of its history.

J. I. HAMBLETON: *The behavior of the honey bee* (illustrated).—The speaker exhibited moving pictures showing the life of the honey bee, particularly its method of ventilating the hive and of gathering pollen, accompanying the pictures with an account of the habits of bees.

H. C. BRYANT: *Fancy and fact in natural history*.—The speaker mentioned ancient and modern fables relating to supposed remarkable habits of various birds and other animals, such as the hibernation of swallows, the transformation of a horsehair into a worm, the hoop snake, the connection between toads and warts, and so on. He then described in contrast even more remarkable facts in the life history of various fish, such as the return of king salmon to the streams in which they were hatched, and the spawning of grunion on moonlight nights in the sand at the time of highest tide. The eggs hatch at the next tide of the same height, which comes ten or twelve days later, the young fish popping out of the egg as soon as it is washed out by the water. The eggs can live until another high tide a month later.

J. W. SPENCER: *Observations on Colorado elk herds*.—During the past year occurred the first open season on elk for thirty years in four counties in Colorado. At the time there was much adverse comment in the newspapers based on the supposition that the elk, which had become very tame, would be slaughtered in large numbers. It was found that a day or two of hunting restored all their wariness and vigilance. About 500 young are born per year in the counties concerned, and the total number killed was less than this. The region was overstocked, which forced the elk to do considerable damage to farm products. The speaker believes that with proper care and the provision of sufficient natural winter range the elk can be preserved indefinitely in much of the western country. He considers that the practice of feeding hay to elk during the winter is in the long run harmful to the species.

753RD MEETING

The 753rd meeting of the Biological Society was held in the new assembly hall of the Cosmos Club November 15, 1930 at 8.10 p.m., with President WETMORE in the chair and 115 persons present. New member elected: Mrs. JUDSON D. COBB.

The regular program was as follows:

F. G. ASHBROOK: *Fur farming in Europe*.—The speaker gave an account of the International Fur-Trade Exposition and Congress held in Leipzig last May, at which he represented the United States, and of his observations on

the breeding and marketing of fur animals in Europe. Fur farming is best developed in Norway, Sweden, Germany, and France, but cannot yet be considered an important source of supply for raw furs. The production of rabbits for meat and fur is further advanced than that of other animals. The speaker also exhibited moving picture films showing the fur trade of the United States from the trapping of wild animals and the breeding of fur animals on farms to the finished product.

MELBOURNE WARD, Australian Museum: *Natural history of the Barrier Reef of Australia* (illustrated).—The speaker gave an account of the general features of the fauna of the Barrier Reef with particular reference to that of Northwest Isle in the Capricorn group, illustrating his talk with colored slides and moving pictures showing the characteristic animals.

754TH MEETING

The 754th meeting was held in the new assembly hall of the Cosmos Club November 29, 1930 at 8.10 p.m., with President WETMORE in the chair and 165 persons present. New members elected: E. P. CHEATUM, H. W. GRAHAM, ROBERT OVERING.

A. WETMORE announced that the new reptile house at the Zoological Park will probably be ready for occupancy early in the coming year.

The regular program was as follows:

H. M. SMITH: *Some new and curious Siamese fishes* (illustrated).—The speaker exhibited numerous excellent drawings of new species of Siamese fish prepared by native artists, and described the habits of some interesting species. The climbing perch climbs trees only when their roots or trunks are in the water. It can pass over the ground between bodies of water, moving with a jerky motion. It has a special chamber over the gills permitting it to breathe air directly in case of need.

The shooting fish captures insects perched near the water by shooting a drop of water from its mouth, or if necessary a series of drops. Its effective range is about 1 m., and it can eject water to a distance of 4 m. The speaker has occasionally seen lizards knocked into the water by a drop ejected by the fish and has twice seen cigarettes in the hands of people on verandas over the water put out. The fish has a long narrow lower jaw, and forcibly compresses its gill covers while the mouth is held open, ejecting water held at the back of the gill cavity. Its eyes function very well in the air.

A large number of species of the codfish group occur, some up to 3 m. long. In several species the eggs are incubated in the mouth of the male, which takes six or seven weeks. The eggs are about 1 cm. in diameter and as many as 49 have been found in a fish's mouth. During this period the fish cannot eat and becomes very thin. In one case the speaker found a second batch of eggs was taken in before the first batch had hatched. It is possibly an adaptation to prevent the loss of the eggs in the very muddy river bottom.

G. M. DYOTT: *Motion pictures of jungle life* (illustrated).—The speaker showed moving pictures taken in Assam, Ecuador, and Central Brazil. The pictures from Assam consisted mostly of remarkable views of tigers, showing them sleeping by their prey, interrupting a feast of vultures on a carcass, and crossing a stream. Those from Ecuador were devoted principally to enlarged views of living insects of various orders. The pictures from central Brazil showed the speaker and his companions at different points on their expedition in search of FAWCETT, the English explorer.

755TH MEETING

The 755th meeting was held in the new assembly hall of the Cosmos Club December 13, 1930 at 8.10 p.m., with President WETMORE in the chair and 125 persons present. The President announced the election of Dr. WM. R. MAXON as one of the board of trustees of the Permanent Funds.

A. WETMORE gave briefly the results of his recent work on Pleistocene bird remains from Florida. He has identified 66 species, apparently the largest number of fossil forms yet found at any locality in the United States.

The regular program was as follows:

MELBOURNE WARD, Australian Museum: *Wanderings in North Australia* (illustrated).—The speaker described the fauna and natives of Thursday Island, Murray Island, and the region about Albany Passage, illustrating his talk with still and motion pictures, and concluded with a moving picture of a native dance in which he took part, accompanying the picture with a native chant.

C. W. STILES: *Is international zoological nomenclature practicable? Report on Padua Congress.*—The speaker gave a general review of the development of the International Rules of Nomenclature and especially a history of the Berlin agreement of 1901, according to which the unanimous approval on the part of the Commission at the meeting was prerequisite to the presentation to the Congress of any proposal regarding the Rules.

He then reported on the meeting at Padua, especially on the adoption of the Horn resolution by the Congress on the basis, not of unanimous recommendation by the Commission, but by majority vote in the Section on Nomenclature. He contended that the action by the Congress was (*a*) invalid from a parliamentary standpoint, (*b*) contrary to all precedents in nomenclature from 1898 to 1930, (*c*) contrary to the spirit and effect of the 1901 Berlin Agreement, (*d*) contrary to the words of the same except that the Horn resolution was presented as a "definition" while in effect it amends, (*e*) contrary to the By-laws of the Commission, (*f*) contrary to the Padua 1930 vote 14 to 1 in the Commission on Nomenclature against Proposition 1930*A*, (*g*) a proposition even more radical than proposition 1930*A* which has been consistently opposed by American zoologists, (*h*) that it makes procedure in nomenclature subject to a chance majority vote (and on any motion suddenly introduced from the floor, without international notice) determined by the geographical locality of the meeting of the Congress, and (*i*) makes the Rules of Nomenclature subject to sudden and recurrent (three to five year) changes, thus making them unstable and without reasonable protection to the views of the minority present or to the views of countries and specialties not represented or poorly represented at the Congress.

He suggested that the Biological Society call a meeting of various American, especially Washington, members of committees on nomenclature to consider the situation and to make recommendations. (*Author's abstract.*)

S. F. BLAKE, *Recording Secretary.*

756TH MEETING

The 756th meeting of the Biological Society was held in the new assembly hall of the Cosmos Club January 10, 1931 at 8.10 p.m., with President WETMORE in the chair and 135 persons present. New members elected: DORIS M. COCHRAN, ALMA RUTLEDGE.

FRANK THONE presented the following report on the so-called *autosynthetic cells* recently exhibited by Dr. GEORGE W. CRILE before the American Asso-

ciation for the Advancement of Science.—Dr. CRILE made three extracts from living protoplasm. Ether took out the lipoids; saline solutions removed proteins; after ashing the residue, water took up minerals. These extracts were remixed and they reunited in more or less definite proportions, resembling protoplasm. Small units were formed resembling some of the protozoa. These units seemed to respire, to assimilate proteins, to reproduce by division, to respond to poisons, and to have several other reactions similar to that of protoplasm. They were without the structure characteristic of cells.

The regular program was as follows:

H. F. PRYTHERCH: *Spawning, setting and development of the oyster* (illustrated).—The most critical period in the life history of the oyster is the setting, during which the fully developed larva cements itself to some clean submerged surface such as old shells or stones and then undergoes a metamorphosis into a spat and adult oyster. A study of the setting reaction under natural conditions in Milford Harbor, Conn., showed that it occurred during the low water stage of the tide, or, in other words, when river discharge had its greatest effect on the physical and chemical condition of the water over the oyster beds. Experiments with oyster larvae under controlled laboratory conditions showed that changes in temperature, salinity, hydrogen ion concentration, oxygen content, CO_2 tension, and water pressure would not induce in a single instance the setting reaction. However, if in reducing the salinity, river water was used instead of distilled water, the larvae gave a positive setting reaction, which indicated that there was some substance in the river water which served to stimulate and control their attachment and metamorphosis. Further experiments involving variations in the amount and proportion of the cations and anions of the neutral salts were found to be ineffective in producing setting of the larvae, as were also the compounds of iron, zinc, tin, lead, aluminum, and silver. The only element of those tested which produced a positive setting reaction was copper in the form of a pure metal or as a carbonate, sulphate, or chloride. This heavy metal was effective in concentrations of one part copper to 5 million or 10 million parts of sea water and initiated almost immediately the setting process. In the river water, copper was found to be present in relatively this same amount and is apparently the specific element that is necessary for the attachment, metamorphosis and survival of the oyster. River water from which the copper had been removed by precipitation and filtration was no longer effective in producing setting.

Copper plays an important part in the respiratory processes of the oyster, and its assimilation by the larva would serve to increase the oxygen-carrying capacity of the blood and release cells during metamorphosis for carrying out this function, both of which would greatly facilitate its rapid growth and development into the adult form. Though copper, like other heavy metals, may have a beneficial and stimulating effect in infinitesimal amounts, it will in slightly higher concentrations quickly produce cytolysis and death of the oyster larva.

These studies indicate that in the development, distribution, and survival of marine animals, traces of certain mineral elements in their environment are of considerable biological significance and may constitute some of the chief limiting factors.

By the use of copper in the form of a pure metal or salt, it was possible in 1928 to observe in detail for the first time the setting and metamorphosis of the oyster larva, a brief description of which has been given in Bureau of Fisheries Document No. 1068. (*Author's abstract.*)

R. A. NESBIT: *Biological aspects of conservation of marine fishery resources, New York and New Jersey* (illustrated).—The chief cause of fluctuations in marine fisheries is virtual failure to reproduce in many or most years, with occasional great success. When successful spawning occurs, the whole increase in abundance constitutes a surplus available to the fishery, for successful reproduction is, within wide limits, independent of the size of the spawning reserve. Studies of the scup in New Jersey have shown that its fluctuations in abundance are largely due to variation in success of reproduction and that it is not in need of protection. Studies of squeteague, known also as weakfish, gray trout, and sea trout, have shown that its fluctuations in numbers are due to more complex causes. The fishery does not take a fair cross-section of the population, suggesting the existence of reserve stocks not ordinarily available to the fishery. The absence of yearling squeteague north of Virginia together with their abundance south of Delaware Bay suggests that northern stocks seldom succeed in reproducing and are maintained by migration from southern nursery grounds. This is supported by studies indicating failure of spawning in Delaware Bay in 1929 and 1930. Pending further studies, no additional restrictions of the fishery for squeteague are recommended. (*Author's abstract.*)

W. B. BELL: *Reestablishment of muskoxen in Alaska* (illustrated).—The speaker reviewed action leading up to the granting of an appropriation of $40,000 by Congress for the purpose of securing a herd of muskoxen to be placed in Alaska. As soon as the funds were assured, steps were taken to secure the desired animals from northeastern Greenland through a dealer in Norway who sends expeditions into this region. Thirty-four animals were obtained which were shipped by way of Norway to New York. They were kept in quarantine for a month at the Bureau of Animal Industry Quarantine Station at Athenia, N. J. They were changed abruptly from the native feed, which they had been given en route, to alfalfa hay, which they ate with apparent relish and upon which they continued to thrive. At the close of the quarantine period they were shipped by express to Seattle, thence by boat to Seward, Alaska, where they were placed in box cars and shipped via the Alaska Railroad to the Biological Survey Experiment Station at College, near Fairbanks, Alaska.

A short motion picture film was shown of the animals taken a few days after their arrival at College, showing them apparently content in the Experiment Station inclosure where they are being held. The original circumpolar distribution of muskoxen and their relatives was traced, showing a vivid contrast with their present limited distribution and numbers in northeastern Greenland, a few Arctic islands, and a herd of about 250 animals on the Thelon Reservation in Canada. The subject was further illustrated by a motion picture film entitled, *The Arctic patrol*, which was made available through the courtesy of O. S. FINNIE, Director of the Northwest Territories & Yukon Branch, Department of Interior, Ottawa, in which were shown remarkably fine pictures of muskoxen taken at Devon Island by the expedition sent out by the Canadian government in 1929.

The herd of muskoxen is being established in Alaska for experiments in feeding, breeding, and management, and in determining possibilities for their production as a source of meat and other valuable products. (*Author's abstract.*)

A. A. DOOLITTLE, *Recording Secretary pro tem.*

BOTANICAL SOCIETY

219TH MEETING

The 219th meeting was held at the Cosmos Club October 1, 1929.

Program: C. S. SCOFIELD: *The effect of boron on citrus in California* (illustrated).—In 1918 attention was focused on the toxic effects of boron on field crops in this country through its presence in potash salts from California used as fertilizers in the East. In 1927 it was found that boron in irrigation waters in California was causing injury to citrus and walnuts in that State. A survey of irrigation supplies and of tree crops in southern California has shown that boron occurs in all of the irrigation waters from 0.1 ppm. to 7.0 ppm. of elemental boron. Where the concentration exceeds 0.5 ppm. in the irrigation water there is usually some evidence of injury in the leaves of lemons and walnuts. As the concentration increases more crops are injured until at 7.0 ppm. very few tree crops are free from symptoms of injury. These concentrations refer to the irrigation supply. The concentration of boron in the soil solution is usually five to eight times as high as in the irrigation water. The symptoms of boron injury appear in the leaves, discoloring or killing the leaf tissue and often causing premature shedding. These symptoms may be confirmed by determining the boron content of mature leaves. In lemons the normal boron content of dried leaves is 50 to 100 ppm.; where boron injury occurs the boron content may be ten to twenty times that much. It has not been found that boron toxicity from these low concentrations is manifested in other parts of the plants. The indications are that boron injury occurs through derangement of the processes of translocating the products of photosynthesis in the leaf tissues. Boron in irrigation water above very low concentrations causes injury to a number of perennial crop plants. The indicated remedy is to locate the sources of boron contamination and withhold the high-boron waters from the general supply or divert them to other uses. As to whether or not boron in low concentrations is essential to plant growth, the evidence is also fairly conclusive. There seems to be no doubt that boron is a normal constituent of practically all the higher plants and that in most cases where the matter has been carefully tested these plants grow better when boron is present in low concentrations in the nutrient solution than when it is absent or occurs as a mere trace. Culture experiments with a wide variety of plants have shown that better growth is obtained when the nutrient solution contains 0.2 to 0.5 ppm. of boron than when the concentration is in the order of 0.05 ppm. or less. All of the crop plants so far tested take up boron readily when it is available in the nutrient solution and the quantity absorbed is at least approximately proportional to the concentration in that solution. (*Author's abstract.*)

E. B. LAMBERT: *Studies on the relation of temperature to the growth, parasitism, thermal death points, and control of* Mycogone perniciosa.—The cardinal temperatures for the growth of *M. perniciosa* were found to be 8°C., 24°C., and 32°C. The most vigorous growth was made between 21°C. and 28°C., which is considerably higher than the range of temperatures in which mushrooms are usually cultivated. When the casing soil was infested with an abundance of innoculum there was 100 per cent infection at 21°C. and 15°C., but only occasional diseased specimens appeared at 10°C. The pathogene was killed by prolonged exposure to moderately high temperatures. It was suggested that commercial growers might be able to eradicate *Mycogone* from their casing soil by subjecting this soil to the high temperatures generated in mushroom houses while the manure is going through with its final heat. (*Author's abstract.*)

The meeting was followed by the annual meeting and the election of officers. H. B. HUMPHREY was elected president; GEORGE M. DARROW, vice president; MARION ZEHNER, treasurer; L. H. FLINT, recording secretary; N. R. SMITH, corresponding secretary.

220TH MEETING

The 220th meeting was held at the Cosmos Club November 5, 1929.

Program: M. F. WARNER: *The pathological tulip.*
F. L. MULFORD: *Early-flowering hardy chrysanthemums.*
D. N. SHOEMAKER: *Fall flowers of spring-flowering groups* (illustrated).
K. A. RYERSON: *Bamboos.*
DAVID GRIFFITHS: *How we make more bulbs* (illustrated).

The last paper (the retiring presidential address) was a discussion of methods of propagation in *Narcissus, Tulipa, Hyacinthus, Lilium, Muscari, Chionodoxa, Puschkinia, Trillium, Brodiaea, Tigridia, Ornithogalum,* and a few others. Contrary to the general impression, propagation by seed is one of the most important methods of increasing stocks of bulbs. It is not only the most important method in some genera but is used in nearly all and is the only method employed in some. Lilies are propagated by several methods. Some are reproduced by seed only, while scale, layered stem, stem bulblet, stem bulbil, and division of bulbs contribute to increase stocks, some species being adapted to one and some to other methods. The propagation of the hyacinth was described as natural and artificial. The former includes the seed method, used in producing new varieties mainly, and division of the bulb employed in the Roman and a few seminaturalized American strains. The artificial methods consist in scooping, scoring, and coring, the two former being universally employed in commercial production. The production of bulb stock by seed was discussed in detail, and the methods employed in handling lily and other bulb seed under open-field conditions at the U. S. Bulb Station, Bellingham, Washington, were described. Whenever this form of reproduction is applicable in increasing stocks it is the cheapest method known. (*Author's abstract.*)

221ST MEETING

The 221st meeting was held at the Cosmos Club December 3, 1929.

Program: NEIL E. STEVENS: *Forecasting the keeping quality of cranberries* (illustrated).

W. T. SWINGLE: *First American visit to date regions of Morocco* (including 2-reel film on "Pollination and pruning of date palms in North Africa").

222ND MEETING

The 222nd meeting was held at the Cosmos Club January 7, 1930.

Program. P. L. RICKER: *Motion pictures of eastern wild flowers.*
J. E. MCMURTREY: *Some malnutrional diseases of tobacco* (illustrated).
P.S. GALTSOFF: *Rôle of living matter in the chemistry of the ocean.*

SPECIAL MEETING

On January 15th a special meeting of the Botanical Society was held at the Cosmos Club to hear Dr. A. E. DOUGLASS, Director of the Steward Observatory of the University of Arizona on *Tree rings and climate* (illustrated).

223RD MEETING

The 223rd meeting was held at the Cosmos Club February 4, 1930.

Program: H. METCALF: *Willow scab.*

R. F. GRIGGS: *A remarkably preserved fossil palm* (illustrated).

W. W. DIEHL: Ephelis, *a cause of floret sterility in grass* (illustrated).

R. D. RANDS: *The Java meetings of the Pacific Science Association and the International Society of Sugar Cane Technologists* (illustrated by a 3 reel film).

224TH MEETING

The annual dinner of the Botanical Society was held at Meridian Mansions Hotel on the evening of March 4, 1930. Reindeer steak was served with Department of Agriculture specialties. The dinner was followed by the regular program.

H. L. WESTOVER: *Forage-crop explorations in Russia and Turkestan* (illustrated).

W. E. WHITEHOUSE: *Observations on Persian horticulture* (illustrated).

225TH MEETING

The 225th meeting was held at the Cosmos Club April 1, 1930.

Program: R. R. HILL: *On a thousand hills* (one-reel moving picture from the Forest Service).

A. S. HITCHCOCK: *A botanical trip to South and East Africa* (illustrated).—As the guest of the South African Branch of the British Association for the Advancement of Science, the speaker reached Cape Town July 19, 1929, having had opportunity to botanize a few hours on the islands of Teneriffe and St. Helena. During the meetings at Cape Town excursions were made to the surrounding region. Though it was winter many plants were in bloom. A two-day excursion on a special train through the Karoo allowed botanists to examine the curious xerophytic flora of this arid region. At the close of the meetings there was an excursion to Victoria Falls and other points in Southern Rhodesia, the members living on the special train for twelve days. The Victoria Falls of the Zambesi River are 420 feet high and a mile and a quarter wide. Stops were made at Motopos Hills and at the Zimbabwe Ruins. The excursion ended at Beira in Portuguese East Africa. A short stop at Zanzibar gave opportunity to make a good collection on the island. Landing at Tanga in Northern Tanganyika the speaker visited Amani Agricultural Institute, then went to Moshi and Marangu, whence he ascended Mt. Kilimanjaro to the limit of vegetation, about 14,000 feet. The alpine grasses belong to such temperate genera as *Festuca, Poa, Deschampsia* and *Agrostis.* He next visited Nairobi, whence a two-day motor trip was made to the vicinity of Mt. Kenya, though there was not time for the ascent. Through the courtesy of Government officials a trip through Uganda was arranged, crossing Lake Victoria to Entebbe, thence to Kampala and Jinja with one-day stops at several places to collect. The grasses collected in South Africa were only 112, it being winter, but in the more northerly regions grasses were more plentiful, those of the alpine regions being of especial interest. In all, including Teneriffe and St. Helena, 1184 numbers of grasses were collected. (*Author's abstract.*)

L. H. FLINT, *Recording Secretary.*